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PINEY BRANCH (D. C.) QUARRY WORKSHOP AND ITS IMPLEMENTS.[1]

BY THOMAS WILSON.[2]

Prof. W. H. Holmes, one of our most accomplished and versatile members, on Nov. 16, 1889, read before our Society an extended report of his investigations in the quartzite boulder quarry at Piney Branch, which was published in the American Anthropologist, January, 1890, pp. 1–26, and is being reprinted in the 15th Annual Rep., Bur. Ethnology. The work described consisted of an excavation up the face of the hill near Piney Branch, in the form of trenches, one 75 feet long and some places 10 feet deep, and other shorter but similar trenches and soundings in the same neighborhood. At the conclusion of his paper, I stood up and complimented him upon the character of the work, and saying that heretofore speculation and theory in the office and with pen and ink, had been employed, instead of actual excavation in the field with the pick and shovel. I congratulated him and the Society upon the new era inaugurated. I said the fact that I did not agree to his conclusions had naught to do with this question and did not prevent me

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from rendering to him the credit for his new mode of investigation, it being the same I had chiefly pursued during my residence in Europe.

Synopsis of the points made in opposition to Mr. Holmes' theories.

1. I concede that Mr. Holmes made a faithful and correct report of his excavations at Piney Branch and of the objects he found there, and I take no exceptions to that part of his paper.

2. But I except to his conclusions. I propose to show that his conclusions are erroneous and that the pretended facts (outside the quarry), on which he based these conclusions, are not facts but assumptions.

3. I propose to show that the objects which he calls "shop-refuse" and which as such should only be found in quarries and on shop-sites, have been equally wide-spread as are the finished implements which he declares to have been the sole aim of the workman in opening the quarry.

4. I propose to show the leaf-shaped implements which he calls "blanks" and which he says were merely material prepared at the quarry for convenience of transportation and to be worked into implements, were themselves finished implements, well-known and commonly used throughout the world in prehistoric times for spears, knives, daggers, etc., with and without handles; and sometimes put to secondary uses, as all other implements might be when broken or the need for their use had passed.

5. I propose to examine the aboriginal village-sites of the District and its neighborhood, in search of the leaf-shaped blades or "blanks" which Mr. Holmes so confidently asserts were carried from the quarry to "other fields" and for other "destinies," and I will show that the number treated as he says, was insignificant when compared with the material procured and the work done.

6. I propose to show the number of caches in the neighborhood to be insignificant; then, that the number of leaf-shaped blades, "blanks," *not in caches,* was also insignificant; then, that those of quartzite which alone could have come from Piney

Branch quarry, are still more insignificant in number, and, finally, that the number of finished implements, such as arrow- and spear-heads, scarpers perforators, etc., *of quartzite* which alone could have been made from Mr. Holmes' "blanks," is even less than insignificant when compared with the mass of implements made of quartz, felsite, argillite, chert, other material than quartzite.

7. I propose to show that, while his facts are assumptions, (always excepting the excavation) he has committed the double error of deducing a wrong conclusion from them, and I will show not only that the leaf-shaped blades (his blanks)—and along with them his finished implements, were not only *not made* from the "double turtle-back," but that they could not be made from it; and that Mr. Holmes' elaborate theory of manufacture as shown by his arranged series of "single turtle-backs," "double turtle-backs," leaf-shaped blades (blanks) and finished implements, being made one after another, each out of the one preceding, will break in two in the middle, because he cannot make the leaf-shaped blades (blanks) out of the double turtle-back without first practically reducing it to its original condition of an unworked pebble.

8. I will contend that the objects found in the quarry should be admitted in evidence and compared with other similar implements in the determination of their age. If this is not done and we are confined for evidence of age, to the quarry and its surroundings, under the assertion that it belonged to modern Indians, then I will attack its antiquity and attempt to show that it may be even more modern than the Indian, and that the quarry might all have been made while digging boulders with which to pave Pennsylvania Avenue in early times. I do not assert this to be true, but if we are deprived of the evidence of the worked implements and driven to surface indications, I will contend that there is evidence (1) of the trench having been entirely filled and carefully levelled so that the contour of the hill shows no trace of excavation which would not have been done by the Indian; (2) that the only other indications of age are the depth of soil on the surface and the size of the trees growing thereon, both of which might have

been accomplished since the laying out of the city of Washington.

9. I make further objection to Mr. Holmes' theory that it assumes jurisdiction of all questions, controverted or not, concerning the age of the quarry, and decides them in such manner as to preclude all further examination. If his theory that the quarry was opened and worked and the implements made by the modern Indian be correct then his decision closes the investigation and passes a final judgment from which there is no appeal.

I.

A portion of the interested public seem to be of the opinion that Mr. Holmes' excavation at Piney Branch was a severe blow to the possibility of a Paleolithic Period in the United States, if it did not destroy that theory altogether. I was not shaken in my faith. My judgment and, I may say without egotism, my years of study of the subject, have given me such an understanding of it as that the excavation at Piney Branch has not caused me to reverse my opinion. If Paleolithic Man existed in America, the traces will be found elsewhere, and a final adverse decision cannot be made upon evidence from a single locality. Therefore I could bide my time.

If the excavation at Piney Branch belonged really to prehistoric times, it is equally favorable to a Paleolithic Period as against it. The investigation reveals nothing incompatible with that theory. The conclusions of Mr. Holmes as announced in his paper were opposed to this, but conclusions are not facts, and renowned investigators have been known to discover many facts, all true, on which they based conclusions which were all error. There are some things in Mr. Holmes' paper not facts but conclusions stated as though they were facts, frcm which I entirely dissent. Some of these, I propose to examine. In this paper, the facts of discovery, as stated by Mr. Holmes, will be admitted; the errors of argument, theory and conclusion will be combatted.

Prof. Holmes' first five pages (Amer. Anthrop. IV. Jan., 1890.) are employed with the history of the locality; pp. 5 to 9 are filled with a description of the work done and the

method of doing it; at the foot of page 9 commences his description of the art-product. As Mr. Holmes proceeds in his paper with the classification and study of these implements, he announces a primary distinction between those which bear evidence of design and those which do not—p. 11. Every archæologist knows of this as a prime necessity. Every one tries to keep to this distinction. The difficulty is in doing it.

True advancement in science depends on the correctness of the conclusion. To rightly decide this, decides the whole question, not only in this, but in almost every case concerning prehistoric man. Mr. Holmes has no difficulty in this regard. He has supreme confidence in his own ability and admits no possibility of mistake or error. He says same paper, (ibid.) p. 11, "With these distinctions (of design) in mind, the archæologist has but little trouble in recognizing and separating all classes of products and the *uninitiated* with a little careful study may readily learn to do the same. Having handled the products of this shop constantly for a period of several weeks, I have familiarized myself with every variety of form and shade of contour, and *do not feel the least hesitation* in presenting the results of my selection and classification." He then describes his Plate IV, (my Plate XIX), in which "is presented a series of worked stones from this site, which represents every variety of product and epitomizes the entire range of form. Beginning with the boulder *a* from which two chips have been taken, we pass through successive degrees of elaboration, reaching final forms in *k*, *l*, *m*, long leaf-shaped blades. * * If it be asked how I know this series is complete * * the discarded remnants tell the story, * * if every entire flaked tool had been taken from the spot, the record would remain with a certainty that is absolute."

He describes, *seriatim*, the manufacture through the first two stages, and he showed practically before the audience the two processes employed, which consisted of the simple operation of "grasping a boulder in either hand, strike the edge of one against the other so as to detach a flake, then a second and third until the circuit (of the pebble) is completed as shown in *a* to *d* and *n*, Plate IV, thus making a typical turtle-back."

(Fig. 1). The stone was turned in the hand and a second series of blows given on the other side, and the result was a "double-turtle-back," (Fig. 2). The third stage is described in an uncertain and indefinite way, rather out of keeping with the rest of the paper. "If the form (of the first-two stages) developed properly, the work was continued into what I have called, for convenience, the third stage. It consisted in going over both sides a second and perhaps a third time, securing, by the use of small hammers and by deft and careful blows upon the edges, a rude but symmetrical blade. A profile is given at *p.* in Plate IV." It is to be remarked, as a matter of importance, that his manipulations are confined to the first two stages and do not enter upon or pretend to show the third process which reduces the object

Fig. 1.
Free-hand on direct percussion; first step in shaping an implement from a bowlder. (Prof. Holmes fig. 6).

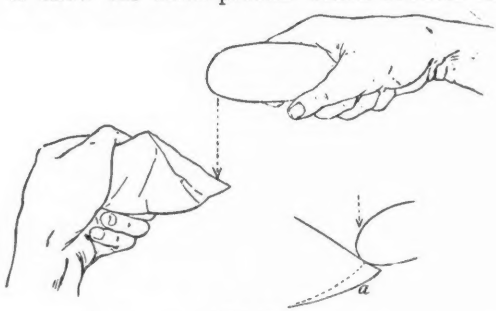


Fig. 2.
Direct percussion; manner of Striking where the edge is sharp. (Prof. Holmes fig. 7).

from a thick and rude implement into "a straight and symmetrical blade less than one-half inch in thickness." There his process fails, and he has not, nor do I believe he

can, by any such process as he has indicated, make out of either his first or second stages, the leaf-shaped implement of the third stage. (I will refer to this later).

His notes on Plate IV are descriptive of the processes and products, and in this he speaks with the air of a master, describing with particularity the intentions and desires of the aboriginal maker, telling wherein he was unsuccessful and specifying the causes of rejection.

First stage—one side worked.

"*a.* Boulder with two flakes removed.

b, c, d. Specimen worked on one side only and had *probably been rejected on account of perverse fracture or excessive thickness.*

Second stage—both sides worked.

e. A few flakes removed from the back; *fracture perverse.*

f, g. Carefully worked on both sides, but still excessively thick, *hence the rejection.*

h. Broken by a stroke *intended to remove a prominent hump.*

Third stage—both sides worked.

i. Neat in shape, but with a ridge or hump on the back which *many strokes have failed to remove.*

j. Unsymmetric broken blade.

k, l, m. Thin, neat, broken blades. * * The last specimen of the series, *m*, is, perhaps, *the most advanced form found*, but that *it was not finished* is clear. * * It is highly improbable that we have in the whole series of products of the quarry, here epitomized, *any finished tool,* either whole or represented by fragments. This should *not be regarded as an opinion only; it is a conclusion based upon evidence that cannot be lightly treated* by the scientific investigator."

This is sufficiently positive to admit of no mistake as to the meaning of the writer. It is an *ex cathedra* opinion. It is the conclusion of one who knows, and who knows that he knows. It is the "Thus Saith the Lord" of holy writ. It is the *ipse dixit* of one who speaks by authority rather than the opinion of one who is making his first essay in his new appointment as Archæologist. This short sentence decides off-hand the

the whole question at issue, for it has been my contention that implements such as were described by Mr. Holmes have been found in many parts of the United States and nearly all over Europe, and have in the latter country always been treated as finished implements belonging to the Paleolithic period; and I respectfully submit that my side of the case is not to be overturned by a declaration made with whatever loudness or clamor, or with whatever positiveness and determination, and which, while declared as a fact, is naught but an assertion.

After having described the manufacture, closing with the third process, the making of the leaf-shaped implements, he says, page 13, "Having followed the process to the end, I wish to call *especial attention to the fact*, if my theory be correct, that when this thin blade was realized, the work of this shop and *the only work of this shop was ended*." I ask—What right has Mr. Holmes to make this statement? What evidence is there of it? How can he know its truth? How can he know that the "turtle-back" may not have been intentional on the part of the workman, as well as the leaf-shaped blade? How can he know aught about the intention of the workman except, as can every other person, from the implements themselves and the condition in which they are found and the objects with which they are associated? Continuing, "The process and the machinery had accomplished all that was asked of them and all that they were capable of accomplishing."

What evidence of truth have we in these assertions? Again, "the neat, but withal rude blades, and they only, *were carried away and to destinies which we may yet reveal*," p. 13. Who knows what blades were carried away, and what blades *only* were carried away? Is this not an unwarranted assumption? "Further work, additional shaping, employed other processes, and *was carried on in other fields*." Why? How? In what fields? What further work? What additional shaping? What processes? Where carried? And who knows aught about it? If the writer of these statements had been himself a first-cousin of the paleolithic man and personally present with his kinsman at the close of the Glacial epoch, making notes and sketches of the quarry workshop of Piney Branch,

PLATE XIX.

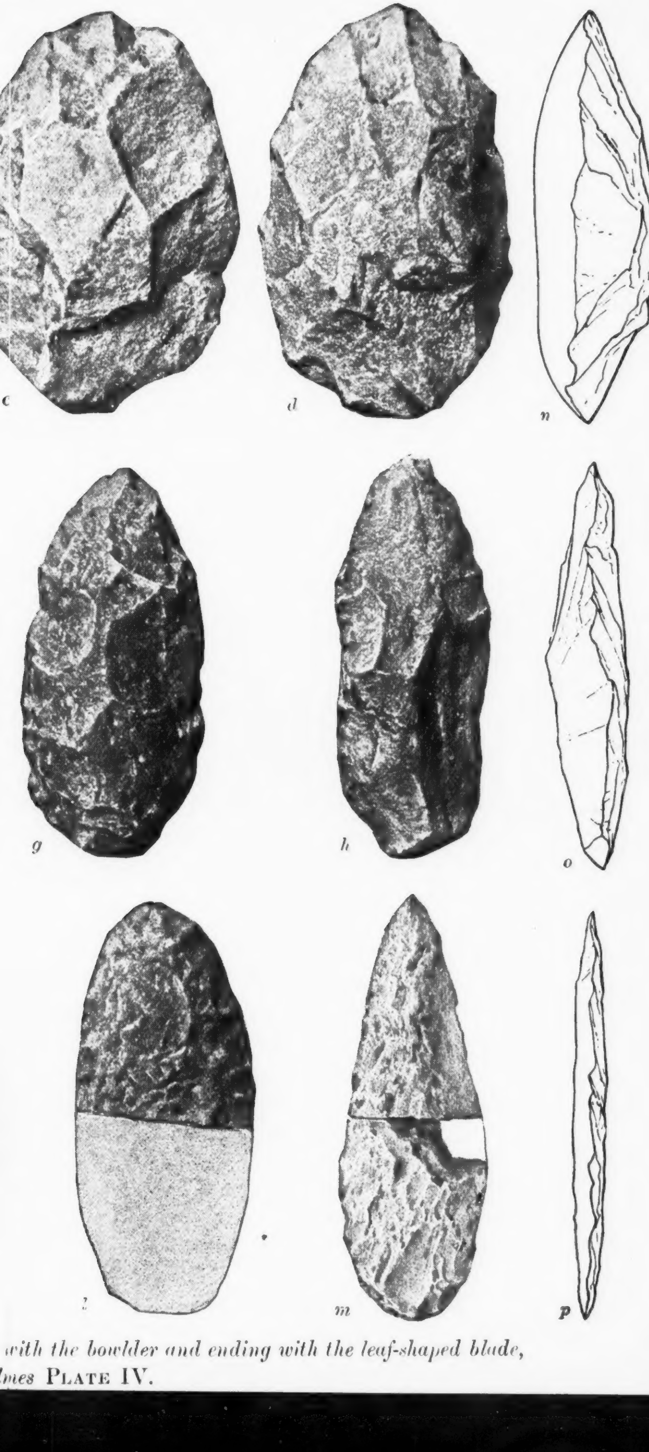
1st Stage—One side worked.

2d Stage—Both sides worked.

3d Stage—Both sides re-worked.

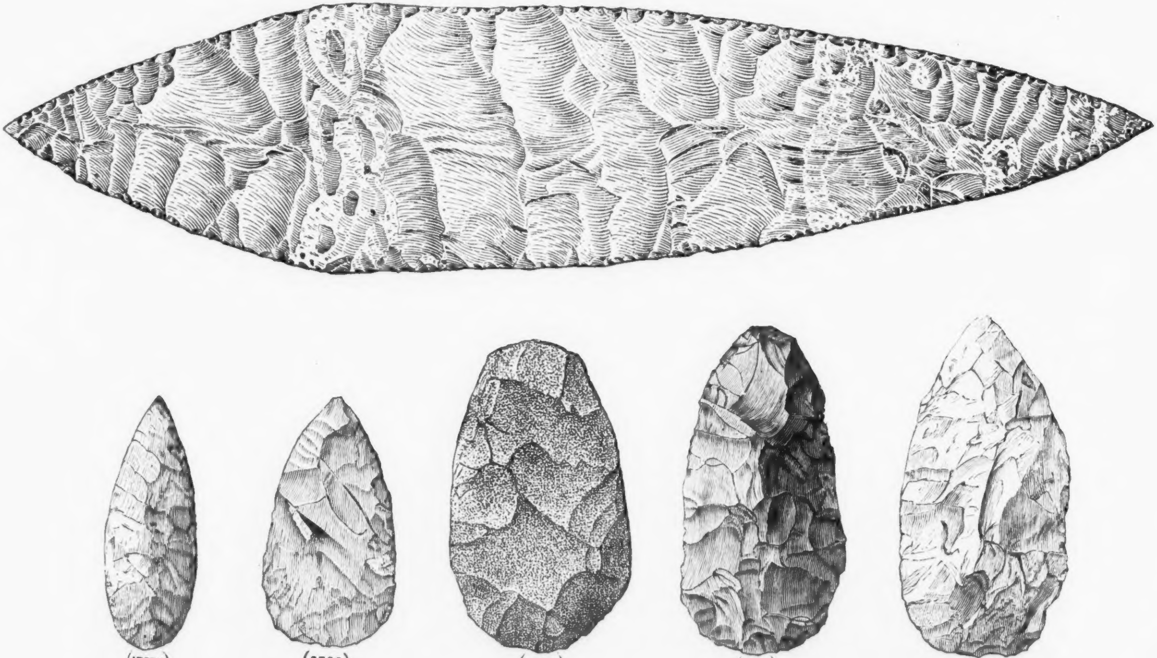
Series of worked objects from Piney Branch quarry, beginning with the bo
according to Mr. Holmes PLATE

XIX.



with the bowlder and ending with the leaf-shaped blade,
lmes PLATE IV.

PLATE XX.



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Leaf-shaped implements, half size. The upper one from France, the lower ones from the United States.

he could not have spoken with greater positiveness and more certainty of knowledge. One might almost be pardoned, if he continued the reading to the foot of page 13, for believing that the writer considered himself not only omniscient but omnipresent. For he says, "That every implement resembling the final form, made from a boulder or similar bit of rock, must pass through the same, or much the same stages of development just described, whether shaped to-day, yesterday or a million years ago, whether in the hands of the civilized, the barbarian or the savage man."

I envy Mr. Holmes his confidence in his acquaintance with the times and men of high antiquity. Such intimate acquaintance with abstruse and unknown problems is equalled only by Dr. Jock Hornbook's acquaintance with medicine and knowledge of drugs; and he repeats this assumption when he says, "There were no examples of successful quarry-products left upon the ground, all forms available for further shaping or for immediate use *were carried away*, being the *entire products of the shop*, and the *only reward* for the long-continued and arduous labor involved in their production."

In the same strain, in the next paragraph, p. 14, he urges us to keep these facts clearly in mind and then says "it is almost superfluous to expend words in showing that all forms found in the workshop other than the thin blade, accidentally lost, are mere waste," and he declares with a heroic "pang of regret" that he is compelled to drop the turtle-back, single or double, wholly and forever from the category of implements and to consign it to the oblivion of "failures." And, as if to make an end to the discussion and settle the question forever, he, in the next sentence, extends his denunciation to all similar forms throughout the Potomac Valley. We should "cast them at once and without hesitation into the refuse."

In the same manner, and with similar sentences, he settles and decides in an off-hand manner, as though it rested upon some great and well-known law and well demonstrated evidence, the very question at issue, and considers that his discovery has put it beyond the pale of intelligent discussion.

"All forms found in the workshop other than the thin blades accidentally lost are *mere waste;* * * * this spot is a great workshop where tools were shaped or rather roughed out, and *these things are the failures.*" P. 14.

This is the precise question, decided so dogmatically and with such an *ex cathedra* opinion, which is the point of the discussion; for it has been contended by those who believe in the probability of a paleolithic period in America, that whatever these implements were, they were not failures, not waste or debris, but were intentionally made, and whether they were or were not implements of the paleolithic man, they correspond in a remarkable degree with undoubted paleolithic implements found in nearly every country of Europe.

Mr. Holmes admits, p. 17, "that to a limited extent (he might well have said unlimited) the rude forms—the turtle-back and its near relatives—*are also found scattered over the Potomac Valley outside the shop on the hills.*" He might have added that they were to be found practically all over the United States. I propose to show that they are even more plentifully scattered over the surface of the hills and fields in the neighborhood of Mt. Vernon than around Washington. "This (the above) would seem to conflict with my former statement that all these are failures and were left upon the factory sites," and he adds "It is time therefore, that I should define a stone-age workshop." Mark the adroitness with which he confines the implements within a workshop and yet accounts for their general dispersion throughout the country. He accomplishes it by defining a workshop to extend all over the country. "It (a workshop) is any spot where an individual desiring to make an implement, picks up one or more boulders or bits of stone, proceeds to shape what he desires.

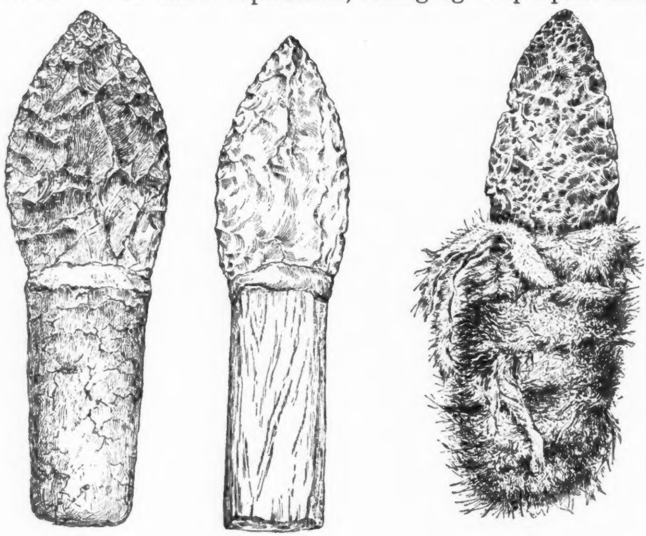
His definition of a workshop is on a par with his other argument. This definition leads him into reasoning in a circle: (1) all turtle-backs are the failures of the workman; (2) this is proved by all the failures being left in the workshops as debris; (3) wherever you find a turtle-back was made, there was a workshop; (4) wherever you find it in a workshop, it was left among the debris. Can any process of reasoning be more

vicious than this? "There is so far no evidence that any inhabitant of the Potomac Valley ever aimed to make by flaking alone any other than the attenuated form," p. 17. "This process leads inevitably to the production of blades *in numbers*, and the supply for the entire year was to be obtained probably within a small fraction of a year, the working period being determined by the season, by tribal movements, or by the limitations of time."

Mr. Holmes disposes these leaf-shaped implements by declaring them (p. 18) to have "been roughed out in numbers to a stage of advancement that made them portable, and at the same time brought them within reach of the processes which he employed in finishing, that they were carried away to the villages and buried in damp earth (cached) until the time came for flaking them into the final forms required by the art. * * * This history of these quarry forms is to be completed by their final distribution among the inhabitants of the various tribes, where we have witnessed the final step in the shaping process —the shaping out of specific forms with a bone tool—and their final adaptation to use and dispersal over the country."

I scarcely know what answer to make to all this. It is so complete and perfect an assumption that one scarcely knows how to make a rational argument against it. I shall refer later to, and show the error of fact contained in this assumption. These leaf-shaped forms have been found in every age of the prehistoric man, in almost every country in the world, they have been of every size—from 16 inches in length down to $\frac{3}{4}$ of an inch. Pl. XX. They are made with all degree of fineness, have preserved their general form and characteristics, and we may imagine in a general way the use for which they were intended. They may have been used as arrow or spear-heads, or they may have been inserted in a shaft or handle and used as spears, or by shortening the handle, as knives; (figs. 3, 4) or they may have been wrapped with hide, bark or grass and this served as a handle (fig. 5). But that they were completed implements ready for whatever use they might have been intended, no prehistoric archæologist of whom I have any knowledge has ever doubted. A duplication and extension

of the uses of nearly every implement may be attributed to the prehistoric man as has been done by the civilized man. No one can prescribe the limits within which a sailor's sheath knife may not be used. A hollow-handled awl is sold in our stores to-day for 50 cents representing itself to be an entire set of tools. The same duplication, changing of purpose and



3 4 5

FIGS. 3, 4. Leaf-shaped implements of jasper, chipped to shape, fastened in wooden handles with pitch or bitumen—to be used as knives, from the Pacific Coast, half size.

FIG. 5. Leaf-shaped blade, chipped, of mattled absidian, wrapped in other skin, used for knife. Collected by Capt. P. A. Ray, from Hoopa Valley, Cal., half size.

adaptation to other purposes, may not have been impossible with the prehistoric man in his employment of these leaf-shaped implements, but that all the leaf-shaped implements, the products of this quarry, and by consequence, all others, should have been but prepared material, wrought from the pebble, to be carried to the home of the man who made them, to be flaked into some unknown and unsuspected implement and then peddled over the country, is an assumption which

has so little foundation as to weaken rather than strengthen his argument. It is only referred to as being on the level with the rest of the paper and to show what a large proportion of it is assumption, and how slight is its foundation of fact.

The method of determining the kind and use of implements, their mode of manufacture and the expected benefit which induced the prehistoric man to expend himself upon them, by comparing him with ourselves, with putting him in our places, or putting ourselves with our knowledge and skill, culture and spirit of invention, in his place, and then deciding everything he did from our standpoint, is one of the errors of modern archeologists and one which leads them far from the right path. This discussion leads Mr. Holmes into the processes of the manufacture of flaked stone tools, and he explains direct or free-hand percussion, declares its limitation, how it was the only method known in early times, and throughout pages 15 and 16, explains the details, giving philosophic dissertations upon the art of stone flaking or chipping and, of the development of the spirit and technology of art required in this work of making leaf-shaped blades. No better answer could be given to this theory than the exhibition of the finely flaked flint implements all prehistoric, coming, some of them, from Scandinavia, Mexico, and a large number belonging to the paleolithic period, found throughout the interior of France in what M. de Mortillet calls the "Solutrèen epoch," M. Reinach and others, the "Cavern epoch." Yet Mr. Holmes has never been able to reproduce one of them or to overcome the difficulties of their fabrication.

(*To be Continued.*)

THE GEOGRAPHICAL DISTRIBUTION OF BATRACHIA AND REPTILIA IN NORTH AMERICA.

BY E. D. COPE.

As is well known, the aggregates of organic beings called faunæ and floræ correspond in part with the natural land divisions of the earth's surface, but not exactly. The first classification of the primary faunæ was proposed by Dr. P. L. Sclater in 1858, as follows:

1. *Paleartic.*—Europe, Northern Africa, Northern and Central Asia.
2. *Ethiopian.*—Africa south of the Great Desert, and Madagascar.
3. *Indian.*—Southeastern Asia and the Malay Archipelago.
4. *Australian.*—Australia with New Guinea and the adjacent islands, New Zealand and Polynesia.
5. *Nearctic.*—North America as far south as Mexico.
6. *Neotropical.*—Central and South America and the West Indies.

Subsequently Dr. A. R. Wallace proposed that the name Oriental be used in place of Indian.

In 1868 Prof. T. H. Huxley proposed that the world's areas be arranged in two divisions, Arctogæa and Notogæa; the former including the Palearctic, Indian, Ethiopian and Nearctic of Sclater, and the latter including the Australian and Neotropical regions. To the last two he added the Novo Zealanian for New Zealand, and he proposes to change the name of the Neotropical to Austrocolumbian.

In 1871 Dr. J. A. Allen proposed the following faunal divisions: I. Arctic Realm; II. North Temperate Realm; III. American Tropical Realm; IV. Indo-African Tropical Realm; V. South American Temperate Realm; VI. African Temperate Realm; VII. Antarctic Realm; VIII. Australian Realm.

In 1874 Sclater modified his system as follows: He retained the term Arctogea in the Huxleyan sense. To the Neotropical region he gave the name of Dendtrogea, and to the Australian

he gave the name Antarctogea, omitting New Zealand and Polynesia, which he constituted a fourth division, Ornithogea.

In 1878 Heilprin proposed the name Holarctic, to include Sclater's Palearctic and Nearctic regions. He also proposed two transitional regions; that of the Old World he called Mediterranean and that of the New World the Sonoran, the latter a term already introduced by Cope for a division of the Nearctic of Sclater.

In 1884 Gill proposed the following primary divisions or realms: 1. Anglogæan (N. American); 2. Eurygæan, or Eurasian; 3. Indogæan; 4. Afrogæan; 5. Dendrogæan, or Tropical American; 6. Amphigæan, or Temperate South American; 7. Austrogæan, or Australian; 8. Ornithogæan, or New Zealand; 10. Nesogæan, or Polynesian. Prof. Gill justly insisted on the importance of fresh water fishes as furnishing definitions of natural faunal realms and regions.

In 1890 Blanford published a system of geographic zoology in which he adopted the primary divisions of Huxley, and divided the Arctogaean region into the following: Malagasy, Ethiopian, Oriental, Aqulonian (= Palearctic and northern part of Nearctic), and Medio-Columbian (S. part of Nearctic).

In 1896 Lydekker proposed the following divisions: I. Notogæic Realm; regions: 1. Australian; 2. Polynesian; 3. Hawaiian; 4. Austromalayan. II. Neogæic Realm; regions: Neotropical. III. Arctogæic Realm; regions: 1. Malagasy; 2. Ethiopian; 3. Oriental; 4. Holarctic; 5. Sonoran. Lydekker makes use of paleontologic evidence in this connection. While this treatment of the subject is important from the point of view of origin, it is often irrelevant, since the distribution of vertebrate life in each geologic age was different from that in each other geologic age.

In an essay on the geographical distribution of North American Reptilia published in 1875, the present writer adopted the first system of Sclater. After a lapse of twenty years, the light thrown on the subject by various investigators suggests the following modifications. In the first place the recognition of the close similarity of the life of the northern regions of the earth, requires more definite formulation than was accorded it in

Sclater's first system, by the union of his three divisions of Nearctic, Palearctic and Indian into one, for which the name Arctogæa is appropriate. The enclosure of his Ethiopian division in it as proposed by Huxley, does not seem to me to be proper, in view of the important types of fishes and reptiles which characterize it; *e. g.*, the Crossopterygian, Dipnoan and Scyphophorous fishes, and the Pleurodire tortoises. In the fishes, indeed, the Ethiopian region has as much affinity with the Neotropical fauna as with any other, in its Characin and and Cichlid families, and in the Dipnoan subclass. The presence of the Dipnoi and the Pleurodire tortoises ally it to the Australian fauna as well. It is for these reasons that Prof. Gill proposes to combine the southern hemisphere realms into a single "Eogaean" division. The northern affinities of the Ethiopian realm are, however, too many to permit us to regard this arrangement as a just expression of the facts. Thus, it has Insectivorous Mammalia, Firmisternial Batrachia Anura, and Cyprinid fishes, none of which are Australian or Neotropical types. The course that remains under the circumstances is to regard the Ethiopian Realm as fully distinct from the other three. The definitions of the four primary divisions are then as follows:

The *Australian realm* is peculiar in the absence of nearly all types of Mammalia, except the *Ornithodelphia* and the Marsupials; in the presence of various Ratite birds, in great development of the Proteroglyph serpents, and absence of the higher division of both snakes and frogs; *i. e., Solenoglypha* and *Firmisternia;* in the existence of *Dipnoi* (*Ceratodus*) and certain Isospondylous families of fishes. On the other hand many of the lizards and birds are of the higher types that prevail in India and Africa, viz.: the *Agamidæ* and the *Oscines.*

The *Neotropical realm* only possesses exclusively the Platyrhine monkeys and the great majority of the humming birds. It shares with the other Southern regions the Edentate and Tapiroid mammals; Ratite, Pullastrine, and Clamatorial birds; Proteroglyph snakes; Iguanid Lacertilia, the Agamids being entirely absent; Arciferous frogs; and Characin, Chromid, Osteoglossid, and Dipnoan fishes. It has but few types of the

Northern regions ; these are a few bears, deer, and oscine birds. Insectivorous mammalia, Viperid serpents, and Ginglymodous, Halecomorphous and Cyprinid fishes are wanting, except on the northern border.

The *Ethiopean realm* is that one which combines the prevalent features of the Arctogean realm with the southern hemisphere types already mentioned, together with some found elsewhere only in the Indian region, and a very few peculiar. The two latter classes not being mentioned elsewhere, they may be here enumerated. The region shares, with the Indian alone, the Catarrhine monkeys, the *Elephantidæ, Rhinocerotidæ*, Nomarthrous Edentata and Chameleons. Its peculiar types are the *Lemuridæ, Hippopotamidæ* and *Protelidæ, Cryptoproctidæ* and *Hyracoidea* among mammals, and *Polypteridæ* and *Mormyridæ* among fishes. It possesses in common with the Neotropical realm characinid, cychlidi, and dipnoan fishes, Pleurodire tortoises and Ratite and Trogonoid birds; and differs from it in the absence of arciferous Batrachia and crotalid snakes, and presence of dendraspid, causid, atractaspid and viperid snakes.

The *Arctogean Realm* is characterized by the absence of types conspicuous elsewhere, and by the presence of a few peculiar forms. Among fishes it lacks Dipnoi and Crossopterygia, Osteoglossidæ, Characinidæ and Cichlidæ. It lacks Pleurodire tortoises and Ratite birds. Ginglymodous fishes and Urodele Batrachia are nearly confined to it, merely extending a little over the border of the Neotropical. Its Cryptodire tortoises extend both into the Neotropical and Ethiopian. Anguid lizards are confined to it. It shares most of its Mammalia with other regions. The Insectivora it shares with the Ethiopian, and its deer and camels with the Neotropical. The genus Ursus is very characteristic, one aberrant species only extending into the Neotropical.

From what has preceded it is seen that the primary differences between the faunæ of the realms are to be found to a large degree in the lower vertebrata, the fishes, Batrachia and Reptilia. These forms furnish stronger distinctions than the birds and mammals, owing to their greater inability to traverse

natural boundaries. Neglect of these indications has led to much of the difference of opinion in the question of geographical distribution, which have been founded principally on the conditions presented by the birds and mammalia.

In this system fragments of existing or old continents, which have been subjected to conditions unfavorable to particular forms of life otherwise prevalent in them, are, as in the system of Sclater, disregarded. Thus, islands generally are not regarded as presenting conditions definitive of divisions of the first rank, as was done by Huxley and Gill in the case of New Zealand, and Gill and Lydekker in the Polynesian Islands. The temperate regions of Africa and South America are certainly not separable from the tropical portions, as divisions of primary rank, as was done by Allen, who is followed as to South America by Gill. With equal propriety western North America might be separated from Mississippi and Atlantic North America, on account of the great deficiency of its fish fauna. In estimating faunistic affinities one has to give similarities over a given area more weight than differences, where the differences are only due to absence of types.

Finally, it must be remembered that there are geographic points of transition between all the realms.

I. The Arctogean Realm.

This realm includes three regions, viz.: the Indian, the Holarctic and the Medicolumbian. I have already defined the first two in general terms. The third is the transitional of Heilprin, the Sonoran of Merriam and Lydekker, and the Neotemperate of Townsend. It embraces what is left of the Nearctic of Sclater after the subtraction of the Holarctic. As the name Sonoran has been previously given by me to one of the districts of this region, I have preferred to use for it the name given by Blanford.

The faunal characteristics of these regions may be enumerated af follows:

Indian Region.—Presence of Holostomatous fishes. Absence of Ginglymodous and Halecomorphous and Salmonid fishes. Presence of Cœciliid Batrachia. Absence of Trachystomatous,

Amphiumid, Cyptobranchid, and Arciferous Batrachia. Presence of Agamid lizards, and Anigiostomatous and Viperid snakes. Presence of Phasianid, Eurylæmid, Nectariniid and Pittid birds. Absence of Tyrannid and of several nine-quilled oscine families. Presence of nomarthrous Edentata, of Viverridæ, Hyænidæ, Tupæidæ and Tarsiidæ. Presence of Rhinocerotidæ, Tapiridæ, Proboscidia, and Catarrhine Quadumana, and Anthopomorpha. Absence of Didelphyidæ, Procyonidæ and Scalopidæ.

Holarctic Region.—Absence of Holostomatous and Halecomorphous fishes. Presence of Ginglymodous and Salmonid fishes. Absence of Trachystomatous, Amphiumid and Cœciliid Batrachia, and absence of the Arcifera except the family Discoglossidæ (two species of Hyla excepted). Absence of Angiostomatous and presence of Viperid snakes. Presence of Phasianid, and absence of Eurylæmid, Nectariniid, Pittid and Tyrannid birds, and of several nine-quilled oscine families or subfamilies. Absence of Nomarthrous Edentata, of Viverridæ, Hyænidæ, Tupæidæ, Rhinocerotidæ, Tapiridæ, Proboscidia, Quadrumana and Anthropomorpha (except Homo).

Medicolumbian Region.—Absence of Holostomatous fishes; presence of Ginglymodous and Halecomorphous fishes. Presence of Trachystomatous, Amphiumid, Aciferous and Firmisternial Batrachia, and absence of Cœciliidæ. Presence of Iguanid, and absence of Agamid and Chamæleonid lizards; absence (except three species) of Angiostomatous and of Viperid snakes. Absence of the Indian types of Passeres mentioned, and presence of Tyrannid Clamatores, and several groups of nine-quilled Oscines (Icteridæ Mniotiltidæ, Tanagridæ). Absence of all the specially Indian mammalia, and of the Holarctic Erinaceidæ, and presence of Didelphyidæ (one species), Scalopidæ and Procyonidæ.

In defining these regions I have restricted myself necessarily to types of tolerably high rank, and have not referred to species. This is because species are not generally characteristic of entire divisions, but only of parts of them. One cannot, however, be absolutely exact in such major definitions, since a number of the conspicuous types in each are not universally distributed over these areas.

In comparing the Holarctic with other realms, I have already referred to the number of types which it possesses in common with the Ethiopian, not found in the Neotropical. It has also several in common with the Neotropical, which do not occur in the Ethiopian. These are the Arciferous Batrachia, the Crotalid snakes, and the deer (Cervidæ). The Medicolumbian division of the Holarctic shares other forms with the Neotropical. These are Didelphyidæ and Procyonidæ among Mammalia; Tyrannid, Icterid and Tanagrid birds; Kinosternid tortoises and the Arciferous Batrachian family Hylidæ.

Some of the forms of the Holarctic region are not uniformly distributed over it. Thus the Ginglymodous and Spatulariid fishes only occur in the eastern parts of the eastern and western continents. The same is true of the Silurid genus Amiurus and the Loricate genus Alligator. The Crotalid snakes are not found in the western parts of Eurasia. The Batrachian Cryptobranchidæ have the same distribution.

II. The Medicolumbian Region.

This region was formerly included in the Nearctic of Sclater, and the area thus constituted has the following geographic boundaries. To the south it includes the plateau of Mexico, including the central valley. The Neotropical area bounds it to the east and west, occupying the low-lands or Tierra Caliente to a point 150 miles south of the Rio Grande on the east, (Townsend, Texas Academy of Science, 1895, p. 87), and to Mazatlan, or some point not far from it, on the west. The high land of Oaxaca is its extreme southern outpost. Its northern boundary is thus described by Merriam.[1] The "Boreal" (Holarctic realm) "Province extends obliquely across the entire continent from New England and Newfoundland to Alaska, conforming in direction to the trend of the northern shores of the continent. It gives off three long arms or chains of islands which reach far south along the three great mountain systems of the United States, a western arm in the Cascades and Sierra Nevada, a central arm in the Rocky Mountains, and an eastern

[1] Biological survey of the San Francisco Mountain; N. Amer. Fauna, No. 3, 1890, p. 24.

arm in the Alleghanies, and these interdigitate with northward prolongations of the Sonoran" (Medicolumbian) "province, which latter completely surrounds the southern islands of the Boreal" (Holarctic) "system."

The faunal relations of the Medicolumbian realm may be tabulated as follows:

Agrees with Holarctic in	Differs from Paleartic in	
	Peculiar Forms	Neotropical Forms
Mammalia in general		Bassaridæ.
Except		Procyonidæ.
	Antilocapra	Megadermatidæ.
	Mephitis	Dicotyles.
	Scalopidæ	Didelphys.
Birds, except		Cathartidæ.
		Tanagridæ.
		Icteridæ.
		Clamatores in general.
		Trochilidæ.
	Meleagridæ	Odontophorinæ.
		Alligators.
		Tiid and Gerrhonotid lizards.
		Iguanid lizards.
Emyd tortoises	Chelydridæ.	Cinosternidæ.
Lachesin[illegible]	Crotalinæ	Elapid venomous snakes.
Raniform frogs		Arcifera.
Scaphiopidæ	Plethodontidæ	Engystomidæ.
	Amblystomidæ.	
	Desmognathidæ.	
Diemyctylus		
Cryptobranchidæ		
	Trachystomata.	
	Necturus.	
	Amphiumidæ.	
Percid fishes	Aphredoderidæ	
Cottidæ	Percopsidæ.	
Haplomi	Amblyopsidæ.	
Accipenseridæ.		
Spatulariidæ.		
Cyprindæ	Plagopterinæ.	
	Catostomidæ.	
Gasterosteidæ.		
Salmonidæ.		
	Amiidæ.	
	Lepidosteidæ.	
Petromyzon		

Baird[2] divided this region into three districts, which he termed the eastern, central and western. The eastern occupied eastern North America to the central plains, where they exceed 800 feet above sea-level. The western included the territory between the Cascade and Sierra Nevada Mountains and the Pacific Ocean. In my paper of 1875,[3] I adopted the eastern, central and western districts (calling the last the Pacific), and proposed two other districts, viz.: the Austroriparian for the Louisianian division of the eastern of Verrill, and the Sonoran for the southwestern and Mexican Plateau faunæ. Merriam, in 1890,[4] proposed a different arrangement. Using the name Sonoran for the entire Medicolumbian Region he divided it into "(1) an *Arid* or Sonoran subregion proper, occupying the tableland of Mexico, reaching north into western Texas, New Mexico, Arizona, and southern California; (2) a *Californian* subregion, occupying the greater part of the State of that name; (3) a *Lower Californian subregion;* (4) a *Great Basin* region, occupying the area between the Rocky Mountains and the Sierra Nevada, extending as far north as the plains of the Columbia; (5) a *Great Plains* subregion, occupying the plains east of the Rocky Mountains, and extending north to the plains of the Saskatchewan; and (6) a *Louisianian* or *Austroriparian* subregion, occupying the low-lands bordering the Gulf of Mexico and the Mississippi, and extending eastward south of the Alleghanies to the Atlantic seaboard, where it reaches as far north as the mouth of Chesapeake Bay." According to his arrangement the Eastern Region of Baird and myself is not mentioned.

This classification may be applicable to birds and mammals; but it is not applicable to the fishes, Batrachia and Reptilia, which are much more exact indicators of the histories of faunæ, owing to their inferior powers of migration. The eastern district or subregion is more nearly allied, from this point of view, to the Austroriparian than the latter is to the Sonoran proper, or arid region. This is due, as Baird previously pointed out,

[2] Amer. Jour. Sci. Arts, XCI, 1866, p. 82.
[3] Bulletin U. S. Natl. Museum, I, 1875, p. 55.
[4] N. American Fauna, 1890, No. 3, p. 24.

to the great difference in rainfall between the part of the continent lying eastward of the 100th meridian and that part which lies west of it. This difference is coincident with a profound difference in geologic age between the regions west of that meridian and the eastern district, the former having a short continental history as compared with the latter.

I, however, agree with Merriam in the abolition of the "Central" as a subregion of Medicolumbia.

The relation of the several zoological divisions to these subregions are as follows: The eastern subregion is the original centre of distribution of all the fishes peculiar to the Medicolumbian region, except only the Plagopterine Cyprinidæ. It is the centre of distribution of all the Batrachia, with the following exceptions: The degenerate types of Trachystomata and Amphiumoidea probably originated in the Austroriparian subregion, and the species of Bufo in the Sonoran. The eastern subregion is also the source of the aquatic Testudinata. On the other hand the Sauria of the eastern and Austroriparian subregions are an overflow from the abundant lizard life of the Sonoran region, excepting the family of the skincs, and the genus Anolis, the latter being of Neotropical origin. The snakes also are mainly Sonoran types, including especially the true rattlesnakes. The copperheads and ground rattlesnakes are on the contrary indigenous to the eastern subregion. The Pacific subregion has close affinities with the Sonoran, but of a largely different kind as to its lizards, while the Batrachia have the character of the eastern types as far as they go.

The distribution of types indicates six principal subdivisions, which I call the Floridan, Austroriparian, Eastern, Sonoran, Western, and Toltecan subregions. The Floridan subregion includes the greater part of the peninsula of Florida, being bounded approximately on the west by the Suwanee River. The Austroriparian sûbregion extends northward from the Gulf of Mexico to the isothermal of 77° F. It commences near Norfolk, Va., and occupies a belt along the coast, extending inland in North Carolina. It passes south of the Georgia Mountains, and to the northwestward up the Mississippi Valley to the southeastern part of Illinois. West of the Mississippi the bound-

ary crosses Missouri, extends south along the southern boundary of high lands of Texas, and reaches the Gulf at the mouth of the Rio Grande. The Eastern subdivision is the most extended, reaching from the isothermal line of 77° F. north and from the Atlantic Ocean to the elevated plains west of the Mississippi River. Many of its forms extend up the bottoms of the rivers which flow to the eastward through the plains. The Sonoran subregion extends from the limit of the Eastern as far west as the Sierra Nevada, and south, including Nevada, New Mexico, Arizona, Sonora and the Plateau of Mexico, including the State of Chihuahua, and, perhaps, Durango. It does not cross the Sierra Nevada, but includes the entire peninsula of Lower California. It extends northward on the east side of the Sierra Nevada as far as, including the arid region of British Columbia. It occupies the valley of the Rio Grande, and extends into Texas as far as the Rio Pecos. It extends southward in western Mexico as far as Mazatlan. The Western subdivision extends from the Pacific coast to the Sierra Nevada to an uncertain distance on the Lower Californian Peninsula. At the north it crosses the Sierra Nevada, skips the narrow strip of the Sonoran in Washington, and extends to the Rocky Mountains, including northern Idaho and western Montana. The Toltecan subregion includes the States of Guanajuato, Mexico, and the adjacent elevated regions of Michoacan, Oaxaca and Puebla, including the Alpine regions of the southern Sierra Madre. It is probable that another subregion should be added, the Tamaulipan of Townsend. This is a dry region extending from near the mouth of the Rio Grande to the Rio Soto la Marina in the State of Tamaulipas. More information regarding the fauna of this country is desirable.

The faunal peculiarities of these subregions are well marked. The three subregions included in eastern North America differ from all the others in the abundance of their turtles and the small number of their lizards. Prolific of life, this area is not subdivided by any marked natural barriers. Hence, though its species present great varieties in extent of range, it is not divided into districts which are very sharply defined. The warmer regions are much richer in birds, reptiles and insects

than the cooler; and as we advance northward many species disappear, while a few others are added. The natural division of the eastern part of the continent is then in a measure dependent on the isothermal lines which traverse it, which accord also quite closely with its geologic history.

The *Floridan subregion* is distinguished by the presence of several peculiar genera of Batrachia and Reptilia, and by a number of peculiar species. A special feature is the almost total absence of Batrachia Urodela. The genera are:

BATRACHIA:
Lithodytes,
Pseudobranchus.

SERPENTES:
Stilosoma,
Rhadinæa,
Seminatrix,
Liodytes.

SAURIA:
Rhineüra,
Sphærodactylus.

Lithodytes and Sphærodactylus are West Indian Neotropical genera, and Rhadinæa, besides being Neotropical, extends into the eastern part of the Austroriparian subregion. Five genera are then peculiar. The peculiar species will be enumerated later. Several species of mammals are confined to this region. The genera of birds that do not range north of it are, according to Allen:

Certhiola
Zenæda, *Oreopelia*, *Starnænas* — Pigeons.
Rostrhamus, *Polyborus* — Raptores.
Aramus, *Audubonia* — Waders.
Phœnicopterus.
Haliplana, *Anous* — Terns.

The isolation of the Floridan subregion is due to the fact that the nucleus of the peninsula (which is of Eocene age) was separated from the continent during the greater part of neocene time. If at at any time connected with the Antilles, the period was of short duration.

The *Austroriparian region* possesses many peculiar genera of reptiles not found elsewhere, while the region north of it possesses none, its genera being distributed over some or all of the

remaining regions. The number of peculiar species in all departments of animal life is large. It presents the greatest development of the eastern reptile life. Sixteen genera of Reptiles and eight of Batrachia do not range to the northward, while ninety-nine species are restricted in the same manner. The peculiar genera which occur over most of its area are:

SAURIA:
Anolis.

SERPENTES:
Elaps,
Haldea,
Cemophora,
Tantilla,
Compsosoma,
Farancia.

TESTUDINATA:
Macrochelys.

LORICATA:
Alligator.

BATRACHIA:
Engystoma,
Manculus,
Amphiuma,
Siren.

I have omitted from this list ten genera which are restricted to one or the other of its subdivisions. The *Siren,* the *Cemophora,* the *Anolis,* and the *Alligator,* are the most striking of the above characteristic genera. No genus of lizards is peculiar excepting *Anolis,* which has its greatest development in other than the Nearctic continent. Among Serpents a few genera of Neotropical character extend eastward along the region of the Mexican Gulf, as far as the Atlantic coast, which are not found in any of the northern regions; such are *Compsosoma,* (Central American); *Tantilla,* and *Elaps* (Sonoran). On the other hand, *Abastor, Virginia, Haldea,* and *Storeria,* embrace serpents which it shares with the Eastern region.

This region is the headquarters of the Batrachia, especially of the tailed forms. The majority of species of the tailless genera are found here, especially of *Hyla* (tree-toads), *Rana,* and *Chorophilus.*

There are no less than nine genera of birds which do not, or only accidentally, range northward of this district. They are, according to Allen:

Plotus,	*Conurus,*
Tantalus,	*Chamæpelia,*
Platalea,	*Campephilus,*
Elanus,	*Helinæa.*
Ictinia,	

All these genera, excepting the last, range into South America or further.

Among mammals, but few species and one genus (*Sigmodon*) are confined to it. *Lepus aquaticus* and *L. palustris*, the cotton rat, etc., and a few others, are restricted by it. The fish fauna is very similar to that of the Eastern region.

The *Eastern subregion* differs from the Austroriparian almost entirely in what it lacks, and agrees with it in all those peculiarities by which it is so widely separated from the subregion. No genus of mammals is found in it which does not range into other regions, excepting *Condylura* (star-nosed mole); but numerous species are confined to it, not extending into the Austroriparian. These number from twenty to twenty-five. Among birds, the following genera are, according to J. A. Allen, shared with the more southern region only: *Quiscalus, Siurus, Helmitherus, Protonotaria, Parula, Mniotilta.* No genus of Reptiles, and but one of Batrachians (*Gyrinophilus*), is confined to this region; but it shares all it possesses with the Austroriparian. It has but four genera of lizards, viz.: *Sceloporus, Cnemidophorus Liolepisma* and *Eumeces.*

The *Sonoran subregion* is characterized in the lower vertebrate fauna, by great poverty in fishes, batrachians and tortoises, and abundance of lizards and snakes. Among fishes it lacks the orders Ginglymodi, Halecomorphi and Chondrostei, and possesses only one peculiar group, the Plagopterinæ, a division of the Cyprinidæ. Of usual Holarctic types it possesses only Isospondyli (Salmonidæ) and Plectospondyli; Percomorphi and Nematognathi being absent. The rivers that intersect its central district contain these types, but they must be reckoned as belonging with their bottom lands to the Eastern subregion; the high plains only belonging to Sonoran. The true drainage area of the Sonoran subregion is that of the Colorado.

No genus of Batrachia is peculiar to it, and the following divisions are wanting: Proteida, Trachystomata, Amphiumoida, and all Pseudosauria, except Amblystomidæ (one species). The genus Bufo is the only one that is well represented.

The following genera of reptiles are peculiar to it:

Uta,	*Anota,*
Uma,	*Lichanura,*
Sauromalus,	*Phyllorhynchus,*
Callisaurus,	*Chionactis,*
Dipsosaurus,	*Chilomeniscus.*

It shares the following genera with the Central American subregion of the Neotropical Realm only:

Ctenosaura.
Eublepharis (also in the Indian region).
Phyllodactylus (also in the Columbian Neotropical).
Heloderma.
Hypsiglena.
Salvadora.
Rhinechis (also Holarctic of Eurasia).
Trimorphodon.
Tantilla (also in Brazilian Neotropical).
Cinosternum (also in Brazilian Neotropical).

The following genera of the Sonoran subregion enter the Texan district of the Austroriparian subregion:

Holbrookia,	*Hypsiglena,*
Crotaphytus,	*Rhinochilus,*
Phrynosoma,	*Cinosternum.*
Gerrhonotus,	

Many species are peculiar to this subregion, as will be shown later on.

The *Western subregion* is distinguished by the absence of most of the types of fishes of the humid part of the continent, and the presence of a few. Thus, the Ginglymodi, Halecomorphi and Catostomidæ are absent, while Percomorphi are present. The Batrachian fauna lacks the Proteida, Trachystomata and Amphiumoidea, while Pseudosauria are abundant,

excepting Cryptobranchidæ. All the families of Salientia characteristic of Medicolumbia are present except the Engystomidæ. Among reptiles the genus Charina is entirely characteristic, and Gerrhonotus of the Toltecan and Sonoran faunæ ranges its entire length. It is especially distinguished by the absence of the following genera: First, all of the Iguanidæ exclusively characteristic of the Sonoran fauna, there remaining only *Crotaphytus*, *Sceloporus*, and *Phrynosoma*, which also enter the Texan district of the Austroriparian; by the absence of *Heloderma*, *Ophisaurus* and *Liolepisma*. Among snakes, by the absence of true water snakes (genus Natrix), and the small burrowing Natricinæ, of Opisthoglyph forms, and of poisonous snakes of the genera *Elaps* and *Systrurus*. No genus but *Charina* can be cited as of universal distribution, which is not at the same time found in some other subregion; but several genera occur in one or the other of its districts which do not occur elsewhere. Similarly no genus of birds or mammals can be exclusively assigned to its entire area; but *Chamæa* of the former class and *Haplodontia* of the latter are restricted to particular portions of it.

The *Toltecan subregion* is characterized by the genera it lacks as well as those which it possesses. Thus, it lacks all the genera of Sauria above cited as characteristic of the Sonoran subregion, including those enumerated as passing over into the Austroriparian ecept *Phrynosoma*. It also lacks the following genera of snakes which are found in the Sonoran:

Lichanura,	*Zamenis*,
Pityophis,	*Phyllorhynchus*.
Ophibolus,	
Chilomeniscus,	

From the Austroriparian subregion it differs in the lack of all the numerous genera of Fishes and Batrachia Urodela, which characterize it, excepting only *Spelerpes*. It lacks also the following genera of snakes: *Cyclophis*, *Virginia*, *Haldea* and *Carphophiops*; and *Natrix* is very sparsely if at all represented.

In its positive characters the Toltecan subregion combines certain forms of both the Sonoran and Austroriparian subre-

gions. Of the former character are *Spea, Phrynosoma, Barissia, Gerrhonatus, Hypsiglena* and *Salvadora*; of the latter kind, *Spelerpes, Liolepisma, Osceola, Storeria* and *Systrurus*. Characteristic of Medicolumbia generaly: *Amblystoma, Rana, Sceloporus, Eumeces, Diadophis, Eutænia, Crotalus*. Peculiar genera:

Siredon,	*Hemigenius,*
Thorius,	*Epiglottophis,*
Malachylodes,	*Ogmius,*
Conopsis,	*Ophryacus.*

Neotropical genera: *Oedipus, Anolis, Celestus, Atractus, Ninia, Drymobius, Bothriechis.*

(*To be continued.*)

FOSSILS AND FOSSILIZATION.

BY L. P. GRATACAP.

I.

A fossil, in Paleontology, is any indication of life which has become entirely or partially altered in its substance or condition by the mineral or chemical agencies of its environment. As an " indication " it embraces the widest possible series of remains which have, or could have, any connection with living organisms, from the bones of a vertebrate, the hard parts of an invertebrate, the foliage, fronds, seeds and wood of plants, to the fillings of worm burrows, the tracks of insects, reptiles, mammals, mollusca and crustaceans, and those problematic impressions which have been referred to Medusa, or those by Prof. Hall to the soft parts of an Orthoceras. And it also includes the stony casts formed by the entrance of extraneous mud or silt, sand or chemical deposits within the hard parts of animals upon their death and the disappearance of the soft parts by decay. The hard parts, upon removal by solution, leave the impressions of their interior upon this soft filling which faithfully copies the contour and size of the organism.

These casts form a large group of fossils, and sometimes afford most important information as to the vascular markings and muscular tissues of both crustaceans and brachiopods, though they often perplex the paleontologist by their meagre and unsatisfactory characters. Again, the moulds of exteriors, the phase of preservation complementary to casts must be classed with "fossils." Such impressions often present the superficial ornamentation of shells, and by filling them with soft material as sulphur, wax, or rubber, a reproduction of the original organism in size and form can be satisfactorily obtained. The application of the word "fossil" may be even extended to designate those doubtful evidences of organic life, such as the mixture of the minerals, serpentine and calcite, which have yielded, upon microscopic inspection, some suggestions of organic structure, and with which the famous name of *Eozoon* has been associated, and over which a notable controversy exists to-day. However the term "fossil" is used, its exact meaning from *fodeo* to dig, refers to the most common circumstance connected with the search for fossils, *viz.:* the excavation of rocks or earth, and hence, literally, a *fossil* is a thing *dug out*, implying a past stage of existence in which it has undergone burial and hinting at its subsequent exhumation. This association has no invariable applicability. Fossils are found exposed upon ancient beaches very slightly covered, as in the shell beds at Beauport, New York, where the valves of *Saxicava rugosa*[1] "form a bleached white mass, twelve feet thick, perfectly stratified, and with only sufficient sandy matter to form the lines of division between the strata" (E. Emmons, Geol. N. Y., Pt. IV, p. 129); they are spread upon the surface of wide extents of territory as in parts of Syria where thousands of cardiums, in the form of casts, are seen upon the road and in the fields, from which wagon-loads could be secured, though not a fragment of a shell or a piece of a hinge-tooth, for purposes of identification, are visible (O. Fraas, Aus dem Orient, Pt. II, p. 73). Similarly, in the cretaceous beds of Texas in the

[1] A Lamellibranch or bivalve shell now found living along our coast, from Georgia to the Arctic Ocean; very common from Massachusetts Bay to Labrador, occurring from low-water mark to 50 fathoms or more.

neighborhood of Neu Braunfels, Exogyras and Gryphaeas, are thickly strown over the ground, disengaged by sub-aerial weathering and surface waters from their enclosing marls (F. Roemer, Kreidebildungen von Texas, etc., p. 14, et seq.). Indeed, under some circumstances inhumation quickly destroys fossil remains from the acidic qualities of the soil, as in the neighborhood of Cumanacoa, Venezuela, S. A., as reported by Humboldt[2] (Travels in Equinoctial Regions of America, Vol. I, p. 228, Bohn's Edit.), and we think that, in many instances, fossils have undergone silicification more rapidly when brought under surface conditions where exposed to mineral waters, than they would have if covered in completely, and so removed from the influences of terrestrial circulation.[3]

Yet the word *fossil* is, of course, a distinct reference to a creature living in the past, and, as such, very properly implies entombment of some sort, and, as a fact, fossils are generally embedded in rocks or alluvial and diluvial beds, in clay banks or thinly aggregated beach sands. They may be subsequently exposed by weathering and by removal, but they indicate some sort of initial burial. Their chronological significance indicating the successive phases of animal life in geological time implies a stage-like superimposition with the earliest fossils at the bottom and the latest at the top. As, in fact, such superimposition is only partially, and then locally, perfect—no section of the earth's surface revealing a sheer and consecutive ascension of all the known strata, containing fossils—we constantly find the fossil-bearing rocks forming the surface of wide

[2] Dr. Schwernfurth, in his "Heart of Africa," mentions a soil in which the natives bury their drums, stools, etc., "to give them a permanent blackness." The vegetable acids developed by decomposition in such areas would act more or less corrosively on bone. Mr. J. Richardson tells me that in one year the entire carcass of a cat buried in rich soil had completely disappeared. On the other hand, "the fossil bones of the megatherium of the elephant and of the mastodon, which travelers have brought from S. A., have all been found in the light soil of the valleys and table-lands." Humboldt.

[3] Dr. Otto Kuntze (Nature, Vol. 19, p. 314) has insisted that his observations show that silicified trunks of trees "originate only in air; the siliceous water rises by capillary attraction in the stem, but only on the outside of the trunk does the siliceous solution become solid by drying in the air; from the outside the silicification of the wood cells enters verv slowly to the inner part."

regions, and many fossils are in a more desirable condition, as specimens for study, when surface weathering has revealed them from the matrix and brought them into a clean and significant relief, as in the case of chain corals (*Halysites catenulatus*) in the Niagara Limestone of western New York, or when the solvent of carbonated waters has left them accessible, in a friable and open ferruginous sand, as in the weathered rinds and exteriors of the siliceous limestones of the Schoharie Grit of eastern New York.

Fossils represent the hard parts of animals or such portions of their soft parts as have become replaced by mineral materials. The fleshy organic elements of an animal undergo decomposition and disappear, even though enclosed in sediments of great thickness. Water-carrying oxygen finds its way around them and slowly introduces those putrefactive changes which result in disintegration and solution. But in this process, if it is prolonged, there is a substitution of earthy matter, and an infiltration of silt will assume the form of muscular bands, retain the outline of muscular scars and blood-vessels, while a more obscure course of substitution may slowly replace the chitinous, horny, or even fleshy, appendages with silica, iron pyrite, and other mineral species, preserving them with microscopic fidelity. Many forms of animal life, like the Medusæ, Ctenophoræ, Holothurians and Worms, from their soft consistency, are necessarily almost excluded from a representation amongst fossils, being, at the best, only indicated by impressions. The occasional and unusual preservation of the fleshy parts of extinct animals in ice can hardly be regarded as a contradiction of this universal rule.

The various stages of the natural process by which organic beings become fossils[4] may be conveniently regarded as three —first, the *placement* of the object in its position preparatory to fossilization; second, its sepulture or burial, and third, the mineralogical or chemical changes by which it assumes its

[4] The word "fossil" receives a curious application by old writers, especially by the celebrated Werner, who used it to designate any mineral object extracted from the surface of the earth. Thus minerals become fossils, and he speaks of "'solid fossils," and he divides them into " hard, semi-hard, soft, and very soft." Also see Pinkerton's Petrology.

permanent form or condition as a fossil. The history and discussion of these three steps form a complete history of fossilization.

The placement of an object will vary in its conditions, according to the habitat of the organism. The most general distinction will be between terrestrial (for the most part, vertebrates) or marine (for the most part, invertebrates) organisms, where the contrasted conditions involve contrasted habits and varying accidents and associations. Upon the surface of the land animals may die in numbers, either upon plains or elevated regions, or in the depths of forests, but the rapid action of decay, or the ceaseless activity of flesh-eating insects may soon dissipate their remains, even when the bony skeleton is imposing and highly developed.

The bones of buffalo remain upon the western prairies for four or five years, at least, in a recognizable condition.[5] In the region about Miles City, Montana, the buffalo abounded as late as 1880. After that time, the remorseless zeal of hunters and the avarice of trade had reduced their numbers and brought them to the verge of extinction. According to W. T. Hornaday, "over the whole of this vast area their bleaching bones lie scattered," and many of these have certainly been exposed to the weather for a period of four years, while their condition when collected warranted the expectation of their remaining sensibly unchanged many more. (See the Extermination of the American Bison, Smithsonian Report, 1887, p. 508.)

Upon the visit of the Challenger to Hard Island, of the McDonald Group in the Antarctic seas, Prof. Moseley observes that upon a sandy glacial plain there were strown "bones of the sea-elephant and sea-leopard, those of the former being most abundant. There were remains of thousands of skeletons, and I gathered a good many tusks of old males. The bones lay in curved lines, looking like tide-lines, on either side of the plain above the beaches, marking the rookeries of old

[5] It is interesting to note that Captain Stansbury observes in his Exploration and Survey of Great Salt Lake, that "carcasses of buffalo left on the open prairie are not unfrequently completely cured, or rather 'mummified' in the sun, so that they seldom exhibit any sign of decay."

times, and teaches of slaughter of the sealers. Some bones occurred far up on the plain, the elephants having, in times of security, made their lairs far from the water's edge. A few whales' *vertebræ* were also seen lying about." In dry or temperate regions, bones resist disintegration indefinitely.

In Canada, at Helena, a vast collection of thousands of buffalo skulls are seen, the enduring vestiges from a slaughter of wild buffalo surrounded by Indians at that place.

The structure of bone in exposures where the climate passes through severe extremes is an element of weakness in their preservation. Winding canals (Haversian canals) traverse the substance of hard bone and secure connection with a series of lacunae, distributed through the substance of the bone, by means of minute tubuli (canaliculi). These tubuli radiate in complex tangles from the lacunae. Sarcodic or marrow-like matter permeates these delicate passages, and, in the Haversian canals, blood corpuscles circulate. In the less dense portions of bones, as the extremities of the leg- and arm-bones, head-bones, etc., a cancellated or cellular structure forms a porous area, while long cavities (marrow-cores) filled with marrow occupy the axes of the longer bones. The decomposition of these organic contents at first weakens bone, and commences an insidious process of splitting. Subsequently the bone becomes filled with water, and the labyrinthine chain of chambers, small and large, are saturated. Cold succeeds, and from the expansion produced by frost the bone is shivered with an incalculable number of microscopic rents. These increase until cohesion is overcome and the bone falls apart.

The mammalian remains may also be placed in soft and water-saturated districts, as swamps and estuaries, lake sides and spring bottoms, whither animals have been attracted by supplies of water or because herbage and prey were equally abundant. Bones and osseous remains of vertebrates buried in rich carbonaceous soil must, to some extent, yield to the corroding action of organic acids. The important roll played by organic acids as agents of decomposition has been recognized. The numerous orders of oxygenated compounds known as acids, and which result from the accumulation of vegetable

matter in fermentable masses, have come to be regarded as most universal and persistent in their influence. It has been shown by Dr. H. C. Bolton that organic acids may be successfully employed for the detection and separation of mineral species, and Dr. A. A. Julien (Proc. A. A. A. Sci., 1879) has gathered together in a comprehensive review such inferences of their geological action as observation of their influence today permits. These acids[6] dissolve iron salts and effect disintegrating effects upon hydrated or soluble quartzes. Such active and omnipresent agencies must exert a very appreciable influence upon animal remains, and in conjunction with carbonated waters must render their preservation precarious. Terrestrial vertebrates, whose remains in the soil of forests or grassy plains would be exposed to the injurious attacks of these vegetable extracts and products, would run some considerable risk of being destroyed.[7] The *placement* of such fossils must be somewhat modified for their effectual integrity. It is true that swamps in whose periods of existence many successions of spagnum layers with the associated accumulation of related and contemporary plants have stored up great quantities of organic debris, have been the repositories of bones, and the great vertebrates, whose bones have become inhumed in their acid-laden depths, have been extracted in a reasonable state of preservation. But it is also true that these heavy bones have worked their way down through the superficial and organic layers to clay marl and sandy bottoms, where they were largely protected from the corrosive action of the humus acids which infiltration and drainage of surface waters would have partially removed.

[6] The vegetable or organic acids are mainly humic, crenic, apocrenic, with which there is an adventitious mixture of oxalic, malic, acetic and fumaric acids, which, according to Julien, are introduced "at least temporarily by the leaves, stems, etc., of most plants, many of which are rich in raphides made up of minute crystals of these acids or their salts."

[7] It is a matter of common knowledge that the bones of goats swallowed by boas undergo solution in the animal acids of their host, so that the calcareous exuviae scarcely equals a tenth part of the original mass of bones, while the so called *album graecum* in the faecas of dogs, hyaenas, etc., represents the residue of digested bones.

The Warren mastodon found at Newburgh, N. Y., in 1845, was embedded in a bed of shell-marl, above which rested a layer of red moss, over which, upon the surface, spread a "thickness of two feet of peat-bog." This specimen was in a very perfect state of preservation, revealing almost the entire skeleton of *M. giganteus.* The Cambridge mastodon was also in an admirable state of completeness, though the nature of the enveloping matrix seemed less favorable. This specimen was taken out at Hackettstown, Warren Co., N. Y., in 1845. The character of the deposit in which it was buried was distinctly organic, consisting of one foot of decayed leaves, six inches of whitish sand mixed with vegetable matter, and a yellow layer, resembling manure, offensively odorous. It would seem a reasonable inference that this large quantity of plant debris would have been unfavorable for the perfect preservation of the bones, and that the organic acids resulting from its decomposition would have aided in their removal. Of course, any protection from the air by the overlying seal of earth, clay, or water, would retard and prevent the oxydation by which the elements of cellulose become converted into acids; and bones immersed in vegetable remains under such circumstances may remain, as practically in this case, exempt from the dissolving agencies of vegetable acids. The Cohoes mastodon, found at Cohoes, N. Y., was taken from a river pothole, into which the remains had been carried, and was surmounted by vegetable debris, but had lodged upon an underlying bed of marl and comminuted shale. This skeleton was in excellent condition.

The Ward mastodon, now at the American Museum in New York City, was found at Newburgh, N. Y., in a swampy wet corner of a potato field, and was in a fair state of preservation.

Commenting upon the position of such vertebrate remains, Dr. Warren says: "In nearly all these different spots, the bones have lain at the depth of from five to ten feet below the surface. The same fact is true of deposits near Niagara, described by Sir Chas. Lyell; of those in Virginia, Long Island, the salines of Ohio, Kentucky, and most other places in the western and southern country of the United States.

"The overlying deposits are generally a foot or two of mud, the same thickness of clay, a layer of peat sometimes intervening, and below the clay shell-marl containing everywhere the relics of fresh-water testacea of existing species; some of them perfect, others decomposing. Sir Chas. Lyell, in his geological tour through the State of New York, found at Genessee, the bones of the mastodon in a bed of shell-marl below the peat, corresponding, he remarks, with the situation of the fossil elks of Ireland, generally considered to have been buried in bog-mud or peat swamps, but which, in fact, lie in a stratum of shell-marl."

It seems probable that the enormous quantities of moa bones found in the turbary area at Glenmark, New Zealand, afford some grounds for questioning the destructive influence of vegetable acids. According to Dr. Von Haast,[8] a large swampy tract in Glenmark, covering a depressed region and partaking of the mingled characters of an estuarine and lacustrine basin, contains an incredible number of the skeletons of these great birds. The bones occur here in separated patches or nests, and the impression, made by their distribution, is that of a sudden flight of groups of the birds over this marshy delta which has sunk in places beneath them, and thus entrapped them in constantly increasing numbers. Bones of twenty or thirty individuals, of all sizes and ages, and lying closely packed in spots about five or six feet in diameter, are found with no bones near them, as if, at particular points, the birds had disappeared, one after another, in the enveloping mass of vegetable débris and soft mud. Evidences here are everwhere pleutiful of successive freshets by which accumulations of trees, seeds, stems and drift timber have been formed, which, with the growth of bog plants, created a deep vegetable blanket in which the moa bones are immersed. Four to seven feet of pure black peat are succeeded by two to three feet of more impure peat, in which the bird bones are more commonly laid, and under these a hard clay bottom completes the section. It

[8] Geology of Canterbury and Westland, New Zealand, J. Von Haast. See also Ann. & Mag. Nat. Hist., Aug., 1844, Rev. W. Colenso; Transac. New Zealand Inst., Vols. IV, VI, J. Von Haast.

would seem reasonable to expect a plentiful production of humic acid and its allied compounds under these circumstances, and if, as Julien asserts, these acids attack the phosphates of alkaline earths (phosphates of alumina lime and magnesia), the preservation of the moa bones appears either exceptional or contradictory.

In this connection it must be remembered that in all such vegetable infusions a considerable amount of tannin must accumulate, and its astringent action upon the gelatine of bone has a tendency to protect the bone along the interior walls of its cavities and canals. Lyell is at some pains to illustrate, in his Principles, Vol. II, pp. 508–510, the preservative properties of peat, but these illustrations relate more to its antiseptic properties for the preservation of animal tissues. Thus, in a peat-moss in the Isle of Axholm, Lincolnshire, Scotland, a body of a woman was preserved six feet below the surface; bodies of two persons in Derbyshire, England, were kept quite uninjured in moist peat, and pigs were found intact in a peaty soil near Dubuerton, Somersetshire.

There is also a possibly protective action exercised at times by the organic acids themselves when they concentrate upon a nucleus of bony fragments, precipitates of iron oxide or amorphous silica. This is done by their reduction of iron salts forming organic compounds, or by combination with silica in the dissolved silica of the infiltrating streams. The iron is liberated from solution by oxydation and the silica by decomposition, and both iron oxide and soft silica may be thus introduced into the interstices of the bone and serve as agents of induration. It is said by Von Haast that the moa bone layer at Glenmark is somewhat reddish. This may be attributed to ferruginous encrustations. Again, the action of organic acids on such material as the harder class of bone must be somewhat limited by dilution, and the constant percolation of water from surface water-courses and rains must considerably neutralize the corrosive power of the readily dissolved vegetable fluids. Again, these vegetable fluids are quite liberally employed in making defensive combinations with the mineral matter brought to them in complete solution or mechanically

suspended in the streams passing over and through marshes, swamps, bogs and deltas, and are so divested of any destructive power upon bone. And in any case, the elaboration of these acid products which we are considering would be partial or completely suspended at such depths as are usually given for the repositories of vertebrate remains. Yet, however diverted or minimized may be the action of organic acids and carbonated water upon bone, there can be little doubt that it is considerable, and an important means in many cases of imparting to them much fragility or of entirely disintegrating them.

(*To be Continued.*)

THE BACTERIAL DISEASES OF PLANTS: A CRITICAL REVIEW OF THE PRESENT STATE OF OUR KNOWLEDGE.

By Erwin F. Smith.

(*Continued from p. 804*)

IV.

II. THE HYACINTH (HYACINTHUS ORIENTALIS).

(II) The organism: *Bacillus hyacinthi* (Wakk.) Trev. (1883).

1. *Pathogenesis:*
   (A) Yes.
   (B) Yes (?). The poured plate method was not then in general use. Inoculations were made directly from diseased plants into sterile nutrient fluids, or into tubes of nutrient gelatin, and the resulting cultures may not always have been pure ones, although the writer's own experience has shown conclusively, in case of melon wilt—a somewhat similar disease—that it is often possible to obtain pure cultures in this way, if the culture

media is sterile to begin with and the necessary precautions are taken to exclude surface contaminations and air-borne germs. His experiments were, however, checked and controlled by means of poured plates, whereas Dr. Wakker had advantage of no such exact method. Nevertheless, he seems to have worked with great care, and states positively that although the bacteria were often transferred from diseased plants to the culture media, and also from one tube of media to another, the results were always the same, which could scarcely have been the case were intruding organisms present.

(C) Yes (?). Infections with artificial cultures had not been secured up to March, 1895, and do not appear to have ever been very numerous or very successful. The only experiment which seems to come properly under this head was begun March 4, 1886. The inoculations were made from a liquefied gelatin culture, the fluid being inserted into fresh cuts on the scapes of several (more than five) varieties of hyacinths. In a week all of the scapes began to dry out and soften, from the summit downward; and fifteen days later the greater part of each one was either entirely dry, or soft and flacid. An earlier effort to infect from a bouillon culture failed (Verslag, 1884).

(D) Yes; in part. On microscopic examination of the scapes mentioned under *C* it was easy to determine in them the existence of the yellow disease; but this did not extend into the bulbs. "These experiments [referring to those mentioned under I (5) as well as this one] were repeated and varied with, in general, concordant results."

Conclusion.—Pathogenic nature rendered probable.

Remarks.—As will be seen later on, this organism was imperfectly described, and any bacteriologist having opportunity to repeat and extend Dr. Wakker's experiments should by all means embrace it.

2. *Morphology:*

(1) *Shape, size, etc.*—The bacteria which Dr. Wakker regards as the cause of this disease are represented on his Plate I, Figs. 1–8 (**34**). They are two to four times as long as broad, with an ordinary length of about 2.5 μ. Their form is therefore more or less that of a cylinder, but with rounded ends. They are said to agree tolerably well in size and shape with *Bacterium Termo*. The organism was described as *Bacterium Hyacinthi* in 1883, but was placed under *Bacillus* by Trevisan in 1889. When these bacteria have been in a nutrient liquid for some time a certain number become longer than they were, and now measure 4 μ, while the ordinary length is only 2.5 μ. Later on, as the nutrient matters of the liquid are becoming exhausted, the bacteria diminish in size more and more, and gather into motionless groups, which often have circular outlines and which grow by the accession of new individuals, while the motile bacteria become less and less numerous. Bacteria from the dry slime were found to be only about half the ordinary size, but on placing them in nutrient fluids they resumed their normal size. Examinations were made in hanging drops of nutrient fluid.

(2) *Capsule.*—No mention of any capsule.

(3) *Flagella.*—No mention of flagella. The organism is said to be actively motile in culture fluids. Even those kept for some time in a dry state are said to have acquired motility on placing them in nutrient fluids. In the yellow, viscid slime, as taken from the plant, they are not motile; but motility begins as soon as this is diluted with a $\frac{3}{4}$ per cent. salt solution, or with a suitable nutrient fluid. "After a short time all is life and motion; the bacteria, in the form of straight but very flexible rods, are to be seen moving about actively; individuals in repose are rare. Among the undivided bacteria there are many which are in process of division, and which then show two individuals moving together; these, however, soon separate to continue an independent existence." It will probably be found that the organism is also motile in the plant in early stages of the disease, *i. e.*, before it has multiplied to such an extent as to fill the vessels. Dr. Wakker himself says: " It is evident that

though they exhibit no visible motion in the slime they cannot be entirely without motion in penetrating into the bulb."

(4) *Spores.*—The bacillus produces endospores. Their development and germination was followed with so much care that it appears worth while to give a somewhat detailed account.

"In the cultures already described [those at room temperatures] no spores were found. These had, therefore, to be sought in some other way. They were finally obtained from the liquid cultures by keeping them at a higher temperature. Drops of nutrient fluid containing the bacteria were placed in an enclosure having a uniform temperature, night and day, of 35° C., *i. e.*, at a temperature exceeding the mean temperature of the room by about 20° C. Ordinarily, at the end of ten days, spores appeared, and the characteristic agglomerations of small, motionless individuals did not appear. Subsequently it was found that a temperature of 35° C. was not absolutely necessary for the formation of the spores. In fact, during the summer, when a rather high mean temperature prevailed in the room, some cultures produced spores without artificial heat; but these were never as numerous as those formed in the tubes kept at the uniformly higher temperature of the enclosure. The spores of *Bacterium Hyacinthi* (**34**, pl. I, fig. 1) have that lively bluish brilliancy which is usually so characteristic of the spores of bacteria, and which is caused by the strong refraction of the light. These spores are always a little longer than broad, and form in the interior of the largest rods near the middle, although ordinarily slightly nearer one of the extremities. In consequence of their strong refrangibility it is difficult to decide with certainty whether the rod is swollen around them, as has been indicated for several similar species. This swelling, if it exists, must be very slight, since the spore is not thicker than the bacterium itself. Besides the rods with ripe spores, there are, ordinarily, a great number engaged in forming spores, and these still move about in a lively manner. On the contrary, when the spores have reached full development, the rods which contain them remain motionless and their wall soon disappears, so that the spores become completely free. In this state they

are about 1 μ in length, while their breadth does not exceed $\frac{1}{2}$ or $\frac{2}{3}$ of this size. Each rod produces only one spore. If these spores are allowed to dry on the glass where they have been formed, they may be kept for a long time, and subsequently on placing them in a nutrient liquid the development of new bacteria may be observed. At the time of germination, which is hastened the same as sporogenesis, by an increase of temperature, the spore begins to swell and its cylindric form changes to an ellipsoid. The strongly refractive power is also gradually lost, the middle of the spore first becoming dull while the brilliant gleam still persists more or less at the two extremities (**34**, pl. I, figs. 2 and 3). Here we have the condition which must be considered as the commencement of germination. The wall is split into two portions, which remain united at one side. The central part of the spore from which the refringence has entirely disappeared, is the place where the two halves of the spore open one from the other, and here a baculiform body of slight refringence was observed pushing out (pl. I, figs. 4 and 5). During the growth of this body the sheen also diminishes very greatly at the two extremities of the spore, and soon there is a state which cannot be indicated better than by likening the germinating spore to a hammer, the two portions of the wall of the spore representing the head while the handle is formed by the rod which has issued from the spore (fig. 6). Often after a longer or shorter time, the rod, one end of which is squeezed between the two parts of the wall of the spore, begins an oscillatory movement, and thus succeeds in freeing itself, whereupon it moves through the liquid in the manner common to bacteria, the empty wall being left behind (fig. 6c). In other cases, after escaping from the spore, the young bacterium remain motionless in front of the empty wall for a long time before swimming away. Finally, the rod sometimes drags the empty wall after it (fig. 8). In all cases the rod which has escaped is an ordinary bacterium which soon divides in the manner already described."

The author never found spores in the living hyacinth. This, he says, accords with de Bary's observation on *Bacillus anthracis*, he having never found spores in the living animal.

This absence of spores in the living plant is also in harmony with the fact that in the nutrient liquid the formation of spores begins only when the alimentary substances are exhausted. This, naturally, is never the case in the living bulb. It is not impossible, however, that when diseased bulbs have been entirely destroyed spores may form in the remaining mass if the temperature is favorable. An effort was made to prove that these spores were actually developed from the hyacinth bacillus by allowing a drop of fluid containing them to dry on a slide for some time, and then placing that part of the slide bearing the dry spores in contact with the fresh cut surface of a bulb. In three weeks the yellow disease was discovered in the vessels of the bulb, and it was at once apparent that it had already been developing in these for some time. This experiment was repeated several times, and always with the same result. This, indeed, is not full proof; but when old cultures are used very few vegetative rods are left, and the infection is believed to have resulted principally from the germination of the spores in the sticky fluid that oozes from the cut scales, the bacteria finding their way from this into the vessels.

(5) *Zooglœa.*—No special mention of zooglœa. Possibly the more or less circular or globular groups of motionless rods which commonly appeared in the cultures as they became exhausted are to be regarded as such.

(6) *Involution forms.*—No mention of any involution forms.

3. *Biology.*

(1) *Stains.*—This organisms stains very readily in the most diverse analin colors. The author made a variety of experiments to determine the best method of staining the bacteria in place in the tissues. He obtained the best results with analin browns, especially phenyline brown (Bismark brown), but states that many other colors may be used, *e. g.*, eosine, methyl violet, analin yellows and picric acid. The yellow stains have the special advantage of giving to the preparation almost exactly its natural color. To stain in place, sections made from alcoholic material should be put into a saturated alcoholic solution of the analin brown, left for a few minutes, and then transferred to strong alcohol containing an

extremely small quantity of hydrochloric acid. In this the color rapidly disappears, especially if the fluid is stirred with a glass rod. At the end of a very short time, the length of which varies in different cases, certain parts will be seen to have preserved their color, if the disease is present, while the rest of the section has already bleached. The sections must now be removed immediately to a dish of pure, anhydrous spirits of turpentine, in which they are left until thoroughly penetrated by the liquid. They may then be examined directly or first mounted in Canada balsam, after which they may be kept indefinitely. When the work has been well done the sections will be brown in those parts which contain the bacteria and which were originally yellow, while in all other parts they are colorless.

(2) *Gelatin.*—The culture media was made by adding to water containing glucose and a little meat extract, enough gelatin to give a solid, clear yellow, perfectly transparent mass at ordinary temperatures. This was sterilized by heating from time to time to 100° C. It was then carefully pipetted into tubes which were plugged with cotton, and re-sterilized by heating every day to 100° C., for some days. Pipettes, tubes and cotton plugs had previously been heated to 140° C. Tubes prepared in this way were unplugged, infected with bacteria taken from a diseased bulb (the transfer being made by means of a platinum wire previously heated to redness), quickly closed, and then left at the ordinary room temperature. The organism makes a good growth on gelatin. The gelatin is readily and completely liquefied.

"*Experiment of June 12, 1885.*—The above described operations were made this day, and two days later I saw in all the tubes the gelatin liquefy under the influence of the bacteria. Examination showed that the part not yet liquefied also contained bacteria, so that the latter must first penetrate into the gelatin and then cause its liquefaction. The formation, in the part of the gelatin which is still solid, of white globules consisting entirely of bacteria, served to make this fact very apparent. Bubbles of gas which can only arise from the action of these organisms also developed in it continually. After a short

time the whole mass was liquefied, and the bacteria were found at the bottom of the tube as a thin whitish layer. The liquid is then a clear brown, darker than the original gelatin. The contents is almost odorless.

"This experiment was repeated very often, and always gave the same result, only in subsequent experiments, it happened sometimes that the white globules did not appear. This, however, is not surprising, since I then employed a mixture (glucose, extract of meat, gelatin) of slightly different composition, and since, moreover, the temperature was not always the same. On peut naturellement infecter aussi quelques tubes au moyen de Bactéries prises dans d'autres tubes; cela n'a jamais rien changé aux résultats."

No gelatin roll or plate cultures were made, and the behavior of the organism in stab and streak cultures is not carefully described.

(3) *Agar.*—No account of any experiments on agar media.

(4) *Potato, etc.*—Nothing mentioned.

(5) *Animal Fluids.*—The first artificial medium was made by adding a little meat extract and grape sugar to a decoction of meat which had been kept for some time in spirits, and was freed from the latter by washing and boiling in distilled water. It was then boiled for an hour in an additional quantity of distilled water and the sugar and meat extract added. It remained clear for ten days, was then reboiled, cooled quickly, and a small quantity of the yellow slime introduced, the greatest care being used throughout to avoid contaminations. The second day this fluid became distinctly clouded, and this clouding increased for four days, and then remained the same. The inoculations that failed were from this culture. The slime used to infect this culture came from a single vascular bundle of a freshly cut bulb. It was scraped off on a flamed cover-glass, which was then thrown into the fluid. The organism also grew well in a solution of meat extract to which glucose had been added. This was the fluid culture medium ordinarily employed, and there is no mention of any other. The exact composition of the medium is not given.

(6) *Vegetable Juices.*—None mentioned.

(7) *Salt Solutions and other Synthetic Media.*—No mention of any; but since the organism is not strictly parasitic it is inferred that it can grow and maintain itself for a long time in a variety of organic substances.

(8) *Relation to Free Oxygen.*—The organism is aerobic and probably also facultative anaerobic, although no mention is made of any experiments to determine this point.

(9) *Reducing and Oxidizing Power.*—Peptonizes gelatin.

(10) *Fermentation Products and other Results of Growth:*

(a) *Gas Production.*—Organism produces gas in meat extract gelatin containing grape sugar. Kind of gas not determined.

(b) *Formation of Acids.*—No statement.

(c) *Production of Alkali.*—No statement.

(d) *Formation of Pigment.*—In the vessels of the plant the organism produces a bright yellow color, which is soluble in glycerin, but insoluble in water and alcohol. This pigment became darker on drying. The dextrose, meat extract gelatin became darker colored (clear brown) after liquefaction.

(e) *Development of Odors.*—The organism produces little or no odor either in the plant or in the artificial cultures. This absence of odor may be used to distinguish the disease from other hyacinth diseases, some of which are very malodorous.

(f) *Enzymes.*—Evidently not studied. Organism produces at least two; one capable of peptonizing gelatin, and another which dissolves the cellulose of the hyacinth.

(g) *Other Products.*—None mentioned.

(11) *Effect of Dessication.*—The organism can be kept for a long time in a dry state without dying, *e. g.*, on a glass plate. It shrinks to about one-half normal size, but on placing again in suitable fluids it recovers its former size and makes a new growth. One of these hanging drop cultures was begun in a somewhat different way. The bacterial slime was not taken directly from a bulb but from a glass plate on which it had been placed and dried long before. The slime and the nutrient fluid were then mixed in the same manner as before; but instead of rods 2.5 μ long, the bacteria were now smaller. Moreover, at first they were distributed through the liquid passively,

and a longer time passed than in the other cultures before their own movement appeared. Nevertheless, after some hours, it began, and first as a simple rotation. At the same time it was determined that the dried bacteria had been reduced to about one-half the ordinary size. But the following day they had resumed the ordinary size, and then also showed the characteristic backward and forward movement. From this point on the culture presented the identical phenomena described above. This shows that the bacteria of the *maladie du jaune* can live for a long time in a dry state, and that on drying they are reduced to dimensions comparable to those which they assume in a liquid in which the alimentary substances are becoming exhausted. I infer that this dry mucilage did not contain spores.

(12) *Thermal Relations:*

(a) *Maximum for Growth.*—Not determined.

(b) *Optimum for Growth.*—Not determined. The organism grows at living-room temperatures, and also in the thermostat at 35° C.

(c) *Minimum for Growth.*—Not determined. The natural progress of the disease in the hyacinth fields appears to be slow, and probably low temperatures may have something to do with this.

(d) *Death Point.*—Not determined.

(13) *Relation to Light.*—Not determined.

(14) *Vitality on Various Media.*—Seems to be capable of living for a considerable period in various media.

(15) *Effect on Growth of Reaction of Medium* (*acid, neutral, alkaline.*—No statement.

(16) *Sensitiveness to Antiseptics and Germicides.*—No statement.

(17) *Other Host Plants.*—No mention of any. Some speculation as to origin of the disease, but no facts.

(18) *Effect upon Animals.*—No statement. Probably not tried.

(III) ECONOMIC ASPECTS:

(1) *Losses.*—No statement as to the extent of damage done by this disease. The disease is spoken of in one place as the chief subject of his investigations, and in another place the organism is called a " dangerous parasite."

(2) *Natural Methods of Infection.*—Little that is definite can be gathered from Dr. Wakker's writings. The sticky slime which oozes from rifts in the affected leaves is highly infectious, adheres to whatever it touches, retains its vitality for some time, and is readily borne about on light objects. He discusses the possibility of the germs entering through the blossoms, and considers that wounds are more likely sources of infection, because the attacked blossoms would fall off quickly and carry the germs with them. It probably enters the plant through wounds made by man or animals. Dr. Wakker thinks it especially likely to enter through wounds of the scape made in cutting the flower, or through injuries done to the young scales by pulling leaves, or by cutting healthy bulbs with infected knives in process of making incisions in the bulb, or of separating the scales for purposes of reproduction. It is evident, however, from the fact that the greater number of the plants are first attacked at the tip of the leaf, that some other unknown method of infection is the more common one. Dr. W. thinks the infection often takes place very early in the spring and generally through the air, the sticky bacterial exudate from the leaves, etc., being carried to sound plants by wind and rain, or by flies and other insects which frequent the hyacinth fields on warm days (Verslag, 1883). For various reasons Dr. Wakker thinks that the parasite may sometimes enter through the uninjured leaf, *i. e.*, through the stomata, but does not appear to have induced the disease in this way. Wounds are always moist, and the bacterium finds food ready for its use in the dead cells of the wound, whereas if it enters through the stomata it must make its own food from the start. The stomata are also very small, and infection through the uninjured leaf surface is probably uncommon.

(3) *Conditions Favoring the Spread of the Disease.*—Dr. Wakker states that the spread of the disease is favored by wet weather, and that dry weather and continuous sunshine are the best preventives. If the much lessened prevalence of the disease in 1883 as compared with 1882 is to be attributed in part to the precautionary measures taken, it is not less certain that the frequent rains of 1882 did great injury to the plants in this

particular. "In 1883 innumerable were the cases in which I observed that the descending stripe on the leaves was dried out and stopped, so that the bulb was not attacked." The rapidity of the infection depends largely on the temperature, the dampness in the surrounding air, and on the amount of water in the plant itself. The location of the wound might also make a difference.

(4) *Methods of Prevention.*—An inquiry among the growers elicited the statement that there is a great difference in susceptibility. This Dr. W. thinks cannot be denied. Some varieties are very subject; others, in the same beds or gardens, have not been known to be attacked. Many varieties formerly held to be exempt from the disease are now known to be subject; but some remain which have never yet shown the yellow disease, and this cannot be ascribed to mere accident; on the contrary, it can be explained only by assuming that predisposition or readiness to be attacked here plays a prominent part (Verslag, 1883). Anatomically, so far as known, all are alike. Lists of "very susceptible," "less susceptible" and "not susceptible" varieties are given, from which it would appear that single varieties are more susceptible than double ones, and the exemption of the latter is not due to their lesser number. All of the double red varieties and most of the other double sorts are exempt, or but little subject to attack. These lists are based on statements furnished by only seven growers, but include many varieties (Verslag, 1885). Of thirteen varieties said to be very susceptible by several or most of these seven growers only one is double, la Tour d'Auvergne. On this account, difference in receptivity is suggested as a means of combatting the disease. New varieties must not be originated from susceptible ones. Seedlings should be derived from hardy sorts, and by artificial fecundation, the pollen of susceptible varieties being excluded. Otherwise, through the agency of insects, the resulting cross may prove susceptible. The law of heredity is shown still more rigorously in non-sexual reproduction. It is best, therefore, to discard sensitive sorts and try to obtain new ones which are more robust.

In the division of bulbs for propagation the greatest care should be taken never to cut a healthy bulb with a knife which

has been in contact with a diseased plant, at least not until it has been disinfected.

There is another point to which the author desires to call special attention, viz., to the removal of leaves which begin to show signs of the disease at the tip. On May 20, 1883, the diseased leaves were entirely cut away from seventeen hyacinth plants. On September 26th, sixteen of these bulbs were entirely sound, although rather small. The other bulb was entirely decayed; but from what cause, it was no longer possible to determine. Planted in pots these sixteen bulbs blossomed in April, 1884. The following June they were dug up once more, and on cutting them open all were found to be sound. This experiment was tried on many other bulbs, and always with the same success. It was also tried by several horticulturists in their fields with results entirely confirmatory. It is, therefore, certain that the bulb can be preserved by the judicious removal of diseased leaves.

Since the bacteria have always penetrated much further into the leaf than is to be seen with the naked eye, the whole leaf should be removed even when only slightly attacked. The frequent complaint that cutting off the diseased parts does no good, shows that not enough attention has been paid to this. Of course, when the bulb is already infected, cutting off the leaves amounts to nothing (**31**).

Finally, it goes without saying that the debris of diseased hyacinths should not be left in the field or near it, as one might be tempted to do on account of its value for manurial purposes. All such debris should be thrown into a deep ditch and disinfected with quick lime.

Remark.—Considering the time when this piece of work was done, it is remarkably good, and in all of the papers cited the internal evidence indicates a careful, conscientious, brilliant investigator. There can be no doubt that the disease is due to a bacterial parasite; but to complete the proof that the disease is due to the specified organism it should be obtained by infections with pure cultures obtained from single colonies. The organism thus isolated should also be studied under a wider range of artificial conditions than were employed. Indeed, excluding the pathogenic test, it is more than doubtful if the organism could be identified from the description.

EDITOR'S TABLE.

The rules of zoölogical nomenclature formulated by Strickland and adopted by the British Association for the Advancement of Science, in 1842 have been observed by most zoölogists ever since. They are eminently fair, and conducive to the best interests of science, and in broad contrast in certain details to some individual opinions which have been promulgated in recent years.

There is a minor point in which it seems to us that the Stricklandian rule might be amended, and we recommend it to the consideration of the international zoological congress committee on nomenclature. This is the question of the presence or absence of the annectant i in the root of proper names of the second declension—to which most proper names belong. Shall we write Boggsus or Boggsius: Keenus or Keenius; Levius or Leviius, etc.? The British rule provides (Proceeds. Brit. Ass. Adv. Sci., 1842, p. 115) that after a consonant the termination of proper names shall be *us* gen. *i*; while after a vowel the i shall be inserted, so that we have *ius*, gen. *ii*.

This rule, however, does not exactly conform to the usage of the Romans, which was not regular. Thus they wrote Catullus, Catulli, but Sallustius, Sallustii; Corvus, Corvi; Horatius, Horatii, etc. After vowels the custom also varied, but generally the i was omitted since it is unnecessary on the score of euphony. The Romans were, as well known, guided by euphony in the matter, hence the irregularity. It is evident that we should be guided by the same principle, but that in doing so we should endeavor to formulate a rule which shall have no exceptions. Naturalists cannot be expected to remember exceptions in a subsidiary matter like nomenclature.

The reversal of the Stricklandian rule would apparently accord best with the spirit of Latin word composition. That is, an i should be inserted after the root of all proper names of the second declension which ends in a consonant, and no i should be inserted where the root terminates in a vowel. Names of the first class never sound badly with the i, while most of them,—notably those whose roots end in labials and dentals, do sound badly. A vowel precedes the us euphoniously. Thus Dana, Danaus; Perrine, Perrinius; Secchi, Secchius; Gaudry, Gaudrius. Those ending in o and u are not of the second declension, unless made so by the addition of the consonant v, as Sello, Sellovius; Yarrow, Yarrovius.

Our much esteemed contemporary, *Natural Science*, had, in a recent number, three short articles devoted to the denunciation of the describing of species in biology; calling the practice in one of them "a most unprofitable" kind of work. Now comes our equally esteemed colleague, *The Revue Scientifique* (1896, p. 440), and remarks as follows, anent of the recent work of Messrs. C. H. Merriam and E. S. Miller on North American Mammalia: "But really is there not more interesting work to be done on the fauna of the United States? This work, which consists in enumerating and describing species, which is within reach of the most mediocre intelligence, this fastidious care which should be left to those who are not capable of ideas, is this the only work which tempts American Zoologists? Is there not other occupation for their scientific activity? Cannot Mr. Hart Merriam stimulate work of a biologic character?"

We regard the expressions above quoted as an indication of a mild form of megalomania which is not unfrequently found among the users of mechanical appliances in the biological laboratory. The most intelligent cultivators of these important branches of biologic research are, however, well aware that the exact determination of species is fully equal in importance to their own pursuit, for the following reasons, among others. If we regard biology to consist of two branches, evolution and physiology, we define evolution, with Darwin, as the origin of *species*. For physiology the question of species is not so important. Species are, however, what the labors of the ages have produced, and it is necessary to know them in order to pursue any branch of evolution (as embryology or paleontology) intelligently. The work of the embryologist and paleontologist who does not know the species whose origin he seeks to explain is greatly lacking in precision. Linnæus states that the tyro knows the higher divisions, but only the expert knows species. We also especially deny that the discrimination and description of species is within reach of the most mediocre intelligence. On the contrary, no kind of work in biology imposes as much on all the mental faculties which are used in scientific work. Those who have not attempted it have little idea what is involved in a diagnosis or an analytical key. Finally, as regards the mammalogic work of Messrs. Merriam and Miller, we consider it of the utmost importance. They are pointing out the results of the evolution of Mammalian life in North America, which it is the business of the embryologist and the paleontologist to explain. And in this field the work of Messrs. Merriam and Miller is the best that has ever been done in any country.

The most important result of the Nansen Arctic exploration which has been so far given to the public is the discovery that the ocean has the great depth of nearly 2000 fathoms north of Franz Joseph's Land. This is the average of the oceanic depths, and the knowledge of its extension to the point nearest the pole yet attained, is a distinct gain. It dispels the idea that the pole can be reached overland from the side of Siberia, and shows that the nearest land approach, as suggested by Peary, is by way of Greenland. While this discovery does not destroy the hypothesis that land exists near the pole, it weakens it. The theory will not become extinct until the northern rendezvous of high arctic migratory birds has been discovered. The remarkable discovery of a territory free from glaciers and covered with vegetation in Grinnell Land, and along the north coast of Greenland, by the Greeley Expedition, opens up interesting possibilities, and must stimulate further search. American citizens have had an honorable share in these in the past, and it is to be hoped that they will continue to attack the problem until it is solved.

RECENT LITERATURE.

The Earth and Its Story by A. Heilprin[1] fills a want long felt by teachers of elementary geology. It is a well illustrated little volume which presents "briefly, forcibly and possibly in a more popular form than in most books of a similar nature, the general facts of geology." It covers the field that it is intended to cover in a remarkably satisfactory manner. The facts of the science are given in sufficient detail to impress the student with the notion that the generalizations based upon them are built upon a secure foundation. Comparatively slight stress is laid upon these facts, the greater emphasis being placed on the general truths to which they lead. The book is interesting. It is well written; the language is simple and the thoughts are very clearly expressed. Only the most important conclusions of geology are mentioned, and where the views expressed are not accepted by all geologists, the author does not hesitate to mention the fact.

A prominent feature of the book are the illustrations. These are mainly reproductions of photographs, many of them entirely new. A

[1] Angelo Heilprin: The Earth and Its Story, a First Book of Geology. Boston, Silver, Burdett and Co., 1896. Pp. 267 and Plates 64.

few are blurred, but the majority are sufficiently full of detail to be of great aid to the reader. Two might well have been spared without injuring the value of the volume in the least—the map of Mammoth Cave (Plate 22, Fig. 2) on which the lettering is so small as to be read with difficulty, and the plate supposed to show the forms of crystals.

Criticism might well be urged against the table of geological "epochs and formations," since the terms 'primary' and 'secondary' are used in conjunction with Paleozoic and Mesozoic, as though they were in as frequent use as the latter, and the term 'tertiary' is used as synonymous with Cainozoic. 'Azoic' is also used as the time term corresponding to the formation term Archean, in spite of the fact that the presence of fossils in the Archean rocks (Huronian and Laurentian) is not positively denied. Finally the term Algonkian has no place in the table. While, of course, it is permitted to the author to decline to accept this term as having a definite significance, it is at the same time unfortunate for his readers that they are not made familiar with it, if only as an aid toward the understanding of the handsome geological maps of the U. S. Geological Survey.

There are 19 chapters in the book. The first three treat of rocks, their formation and decay, the fourth of mountains, the next two of glaciers, the seventh of underground waters, the eighth of the relation between sea and land, the ninth of the interior of the earth, the tenth and eleventh of volcanoes, the twelfth of coral islands, the next three of fossils—their organization and their teachings, the sixteenth of land surfaces, and the last three of metals, minerals, building stones, etc.

No one need hesitate for an instant in recommending this little volume for use in our high schools and academies. It is by far the best thing of its kind that has yet appeared upon the market.—W. S. B.

A Handbook of Rocks, for use without the Microscope by Dr. J. F. Kemp[2] is a very welcome visitor to the desk of the teacher of geology. There has long been needed a little treatise on lithology which might be used as an introduction to the study of rocks and as a text-book for the use of those students in geology who have no intention of taking up the subject as a specialty. The volume before us fills this need completely. It is an excellent little book, as full of detail as is desirable for a book of its character and as accurate as is possible in one of its size. Each of the main families of rocks is well characterized

[2] J. F. Kemp: A Handbook of Rocks, for use without the Microscope with a glossary of names of Rocks and other Lithological Terms. Printed for the author. New York, 1896, pp. vii, 176. Price in lots of ten copies $1.00 each.

in a few discriminating sentences, analyses of many varieties are given and the structures and textures of all are well described. One of the most commendable features of the volume is the use of only the more important rock-names in the body of the text—the less important ones being relegated to a very comprehensive glossary which forms a convenient appendix to the book. In this respect, as in some others, the volume under review is very much more satisfactory to the untechnical reader than the other volumes of similar character that have recently come under our notice.

The work opens with a description of the rock-forming minerals and a discussion of the principles of rock classification. Following this are the descriptions of the rocks. These are divided into Igneous, Aqueous (including Eolian) and Metamorphic rocks. Each class is divided into groups according to chemical composition, and each group is further subdivided according to texture. The classification is an eminently practical one, and at the same time it can give no offense to the micoscopical lithologist.

In the discussion of the rock-types each chapter begins with a list of analyses; this is followed by comments upon them. Then comes a description of varieties, a statement of relationships, a paragraph on geological occurrence, one on alterations and one on distribution. In that portion of the book that deals with the igneous rocks the glasses are first taken up, then the porphyritic varieties and, finally, the granitic ones. The aqueous rocks are grouped as mechanical sediments, limestones, organic remains and precipitates from solution. Of the metamorphic rocks two great classes are recognized, viz., those produced by contact action and those produced by regional metamorphism.

The above outline of the contents of the volume is very brief, but it is sufficiently full to indicate that the author has covered well the field that such a treatise as this one should cover. This book should find a wide sale among engineers as well as among all teachers who introduce into their courses on geology a description of rocks. It is a far more valuable synopsis of the characteristics of rock types to place in the hands of geological students than the synopses contained in the large text books on geology.—W. S. B.

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General Notes.

MINERALOGY AND CRYSTALLOGRAPHY.[1]

Etched Figures on Some Minerals.—Traube[2] brings into deserved prominence the value of the method of etching, and gives the results of an extended series of experiments on the etched figures of a number of minerals. He mentions especially those cases in which the etched figures indicate a higher symmetry than that occasionally shown by the geometrical development of the crystal form. He evidently lays more stress on the etched figures of crystals than on the occasional growth of planes corresponding with a lower symmetry. K F and K F, H F are mentioned as giving good results in many cases where the problem is to etch one of the more refractory silicates, and a caution is given that care must be taken in the use of such powerful reagents.

On cuprite etched figures were produced by H_2SO_4, HCl, HNO_3 and KOH, dilute HNO_3 giving the sharpest figures. The etching indicates a holohedral regular symmetry, notwithstanding that Miers has observed faces of the form (986) in a position suggesting gyroidal hemihedrism.

Phosgenite gives sharp figures with hydrochloric, sulphuric, nitric and acetic acids, also with the caustic alkalies, all pointing toward holo-

[1] Edited by Prof. A. C. Gill, Cornell University, Ithaca, N. Y.

[2] Neues Jahrb. B. B. X, pp. 454-469, 1896.

hedral symmetry. The forms developed on some crystals from Monte Poni had suggested trapezohedral hemihedrism in the tetragonal system.

Wulfenite from several localities has been reported to be hemimorphic, on the strength of the polar development of the crystal form, but neither the etched figures nor the pyroelectric behavior of the crystals bears this out. Both wulfenite and scheelite act alike in these latter respects and appear to be pyramidal hemihedral, without difference in the two directions of the vertical axis.

Chalcolite, disthene, tourmaline, vesuvianite, dioptase, willemite, nepheline, beryl, adularia and some of the triclinic feldspars were also etched, with the result of confirming the higher symmetry in each case where doubt could exist. Nepheline, as already established by Baumhauer, belongs to the pyramidal hexagonal class of Groth (1st hemimorphic tetartohedral division of the hexagonal system, Liebisch).

Pollucite, Mangano-columbite and Microlite from Rumford, Maine.—These minerals were discovered in pegmatite associated with quartz, feldspar, muscovite, tourmaline, lepidolite, spodumene, amblygonite, beryl, cassiterite and columbite. They are described by H. W. Foote.[3] The pollucite, though rare, occurs in rather large masses difficultly distinguishable from white quartz. The analysis proves the mineral to be chemically identical with that from Hebron, Maine, and seems to sustain the view of Wells that the formula is $H_2Cs_4 Al_4(SiO_3)_9$.

The Mangano-tantalite is in the form of dark reddish-brown crystals resembling rutile. A qualitative analysis revealed the presence of Mn, Ta and Ni. The specific gravity, 6.44, would indicate that the last two elements are present in about equal proportions. The form differs somewhat from columbite, as shown among other facts adduced, by the axial ratios.

	Columbite.	Mangano-columbite.
a : b : c =	.8285 : 1 : .8898	.8359 : 1 : .8817

Microlite in beautiful honey-yellow crystals 2 mm. in diameter have a specific gravity of 5.17. The prevailing form is the octahedron, modified by the dodecahedron and sometimes by (113).

Epidote and its Optical Properties.—The peculiar appearance of a gray epidote from Huntington, Mass., led to its detailed investigation by Forbes.[4] The light color is evidently due to the low percent-

[3] Am. Jour. Sci., CLI, pp. 457-461, June, 1896.

[4] Am. Jour. Sci., CLI, pp. 26-30, 1896.

age of iron, as shown by the subjoined mean of two closely agreeing analyses.

SiO_2	37.99
Al_2O_3	29.53
Fe_2O_3	5.67
FeO	.53
MnO	.21
CaO	23.85
H_2O	2.04
	99.82

This corresponds with the accepted epidote formula. Some of the angles vary quite considerably from those given by Kokscharow—possibly due in one or two cases to the striated character of the faces.

The optical properties are unusual. The axis of greatest optical elasticity lies in the *obtuse* angle β, making an angle of 1° 51′ to 2° 47′ with the vertical axis, according to the nature of the light used. The optical sign is positive—an unusual thing for epidote. The indices are $\alpha = 1.714$, $\beta = 1.716$, and $\gamma = 1.724$. The double refraction is thus .010, the least value known for the mineral. The optical angle over a, 90° 32′, is exceptionally large. A comparison of the data at hand seems to show that with increasing percentage of iron the double refraction becomes stronger, the index of refraction increases, while the optical angle (over a) grows larger, and when it passes 90° the crystals become optically negative.

Miscellaneous Notes.—Leiss[5] gives details concerning several new models of optical instruments as manufactured by Fuess of Steglitz, near Berlin. The most important of these are a petrographical microscope, a theodolite-goniometer, an optical angle instrument, and a number of devices for universal motion.—Viola[6] shows the application of the quaternion method to the discussion of crystal symmetry, and arrives at results concordant with those of Fedorow, Schönflies and others.—Schwarzmann[7] describes a scale for reading directly with approximate accuracy the apparent optical angle 2E, without the labor of calculating it by Mallard's formula.—Crystallographers will be much interested in the results obtained by Rinne[8] in certain experi-

[5] Neues Jahrb., B.B. X, pp. 179–195; also pp. 412–439, 1895.
[6] Neues Jahrb., B.B. X, pp. 495–532, 1896.
[7] Neues Jahrb., 1896, Vol. I, pp. 52–56.
[8] Neues Jahrb., 1896, Vol. I, pp. 139–148.

ments on heulandite. Anhydrous H_2SO_4 abstracts 2 H_2O from the molecule Ca Al_2 Si_6O_{16} + 6 H_2O leaving Ca Al_2 Si_6O_{16} + 4 H_2O. The latter compound is optically quite different from the original heulandite, having, for example, a much higher double refraction and a different plane of the optical axes. The change may be watched under a microscope, and takes place faster in some crystallographic directions than in others. Dilute sulphuric or hydrochloric acid gives a pseudomorph, which, after heating, is composed of almost pure SiO_2 (only 1.33 per cent bases). It has a specific gravity of 2.143, is optically biaxial with a small angle, and has weak double refraction. It is regarded as a new modification of SiO_2, probably like Scacchi's "granulin."

In continuation of his studies on Algerian minerals, Gentil[9] mentions with more or less detail calamine, smithsonite, sphalerite, calcite, galena, cerussite, limonite and barite from a number of zinc mines. Ilvaite and bustamite from Cape Boujaroun are also studied somewhat at length.—Dufet[10] publishes the results of a crystallographic study of four modifications of indophenol, also of several complicated organic and inorganic compounds which are not at all related to one another. —Lacroix[11] describes the microscopical characters of a number of compact or earthy minerals. They are not amorphous, as they appear to the naked eye, but are all micaceous and crystalline in ultimate structure.—Termier[12] reports seven new forms, and a large number of rare ones, on a quartz crystal discovered on a block of gneiss in the lateral moraine of the lower Grindelwald glacier. The new forms are

$$\bar{7}.7.0.4$$
$$32.\overline{15}.\overline{17}.62$$
$$\overline{11}.\overline{25}.36.0$$
$$10.\overline{35}.25.20$$
$$\bar{1}.4.5.\bar{2}$$
$$\overline{17}.\bar{4}.21.\bar{9}$$
$$\bar{3}.\bar{4}.7.\bar{7}$$

The explanation of these rare faces is sought in the deposition of calcite on the quartz, followed by the formation of "temporary limiting" faces as the crystal again grows, and, finally, the solution of the out-

[9] Bull. Soc. Fr. Min., XVIII, pp. 399–414, 1895.
[10] Bull. Soc. Fr. Min., XVIII, pp. 414–426, 1895.
[11] Bull. Soc. Fr. Min., XVIII, pp. 426–430, 1895.
[12] Bull. Soc. Fr. Min., XVIII, pp. 443–457, 1895.

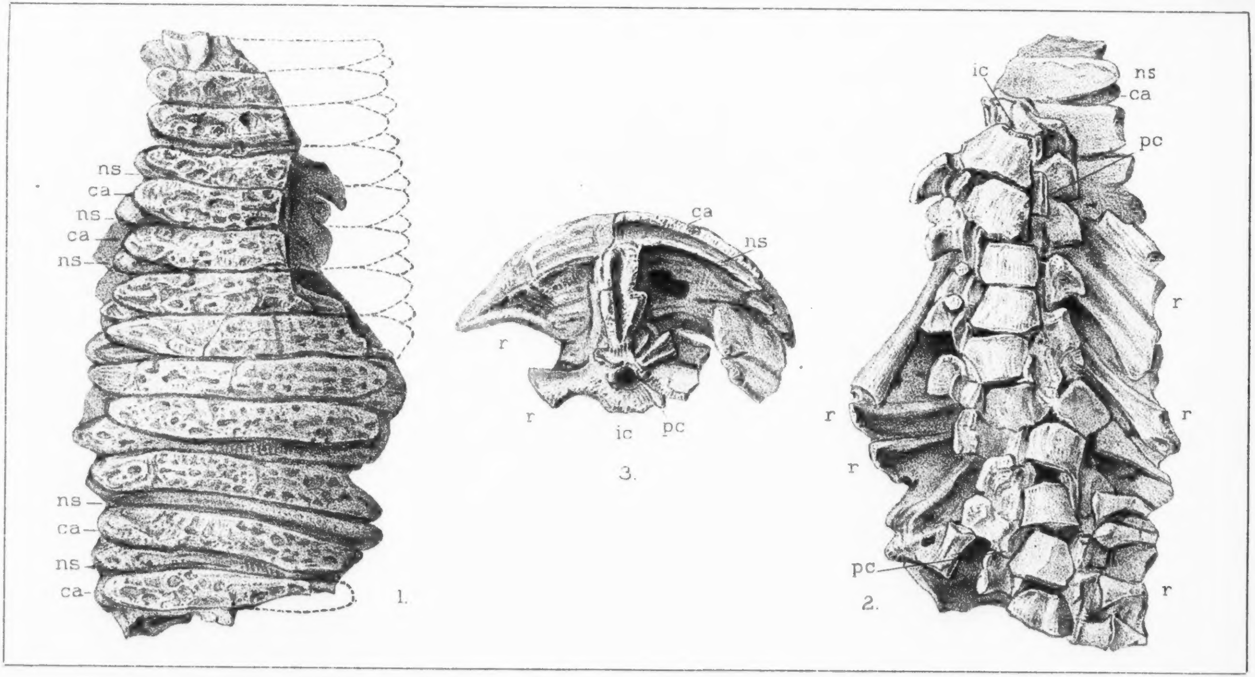
side of the quartz, thus exposing again the unusual faces. Some of the calcite layers are still present in the specimen.

The new mineral lawsonite is more fully described by Ransome and Palache[13] than was the case in the original paper by Ransome. The formula is H_4 Ca Al_2 Si_2O_{10}.—Walker[14] finds that the sperrylite from the Sudbury district probably occurs originally included in chalcopyrite. The new face π (10.5.2) was observed. The suggestion is made that Os and Ir occur replacing Pt in sperrylite, and an analysis of the products of the Murray mine, showing the presence of these elements, is given. (If, as this analysis would indicate, the two elements osmium and iridium are present in an amount equal to one quarter that of the platinum, it is difficult to suppose that they exist in the sperrylite, since Wells states specifically that he found no iridium in the sperrylite analyzed by him).—Adams and Harrington[15] describe a new alkali-hornblende chemically near an orthosilicate, and a titaniferous andradite from the nepheline-syenite from Dungannon, Hastings Co., Ontario.—Merrill[16] notes an occurrence of free gold in a black mica granite from Sonora, Mexico, apparently as an original constituent of the rock.—Crocoite crystals from Mt. Dundas, on the west coast of Tasmania, measured and figured by Palache[17] present, in addition to the twelve known forms the new, though doubtful, prism (10.3.0).

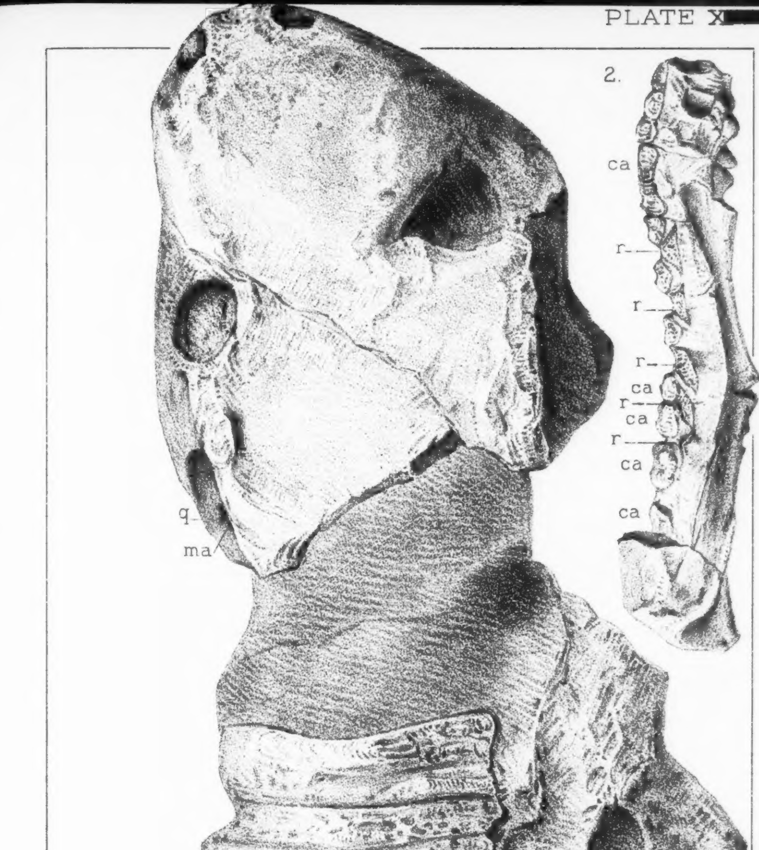
GEOLOGY AND PALEONTOLOGY.

Permian Land Vertebrata with Carapaces.—In the NATURALIST for 1895 (November) I described under the name of Dissorophus a new genus of probably Ganocephalous Stegocephalia with an armadillo-like carapace. In the Proceedings of the American Philosoical Society for the same year and month I described a new family of Cotylosaurian Reptiles protected by a similar structure. These constitute the only forms of land vertebrates so constructed known from the paleozoic formations. The nearest approach to it previously known from the Permian is seen in the genus Zatrachys, where the

[13] Zeitschr. f. Kryst., XXV, pp. 531–537, 1895.
[14] Zeitschr. f. Kryst., XXV, pp. 561–564, 1895.
[15] Amer. Jour. Sci., CLI, pp. 210–218, 1896.
[16] Am. Jour. Sci., CLI, pp. 309–311, 1896.
[17] Am. Jour. Sci., CLI, pp. 389–390, 1896.



DISSORHOPHUS ARTICULATUS COPE 5/6



1. OTOCOELUS MIMETICUS COPE 3/5
2. O. TESTUDINEUS COPE 2/3

species *Z. apicalis* has the apex of the spines dilated and sculptured on the superior or external surface, indicating the presence of a row of osseous shields covered by epidermis only, extending along the middle dorsal line. In the Trias, two such types have been previously known; viz., the genus Typothorax Cope, from New Mexico, and Aëtosaurus Fraas from Würtemberg.

The discovery of the Permian form in question is important from various points of view. The discovery confirms again a hypothesis proposed by me, several years previously (NATURALIST, 1885, p. 247, Transac. Amer. Philos. Soc., 1892, p. 24). It presents us with what had been previously wanting, forms ancestral not only to the Triassic Reptilia above referred to, but also ancestral to the order of the Testudinata, which according to Quenstadt and Baur appears first in the Trias. The discovery also brings to light an interesting case of homoplassy, since we have two families in no way allied to each other, the one a Batrachian, and the other a reptile, presenting an identical character, and which is so closely similar in the two, that the carapaces cannot be well distinguished on an external view. Internally, however, the characters differ widely. In the case of the Reptilian family (Otocœlidæ) the structure is what one finds in the Testudinata and Pseudosuchia (Typothorax); while in the Batrachian it is constructed by an expansion of characters already known in other Stegocephalia.

For the accompanying illustrations I am indebted to the American Philosophical Society.

PLATE XXI.

Otocœlus testudineus Cope, From above x.66.

PLATE XXII.

Dissorhophus articulatus Cope, x.82; 1 above; 2 below; 3 anterior view.—E. D. COPE.

Ameghino on the Evolution of Mammalian Teeth.[1]—The discoveries of M. Ameghino in Argentina have put him in a position to throw a great deal of light on the evolution of the Mammalia. Several problems which are presented by general Mammalian dentition should be greatly elucidated by his material, and some of those suggested by the Toxodont and Edentate types are within his reach almost to the exclusion of other investigators. He has already made important con-

[1] See l'Evolution des Dents des Mammiferes par Florentino Ameghino. From the Bull. Acad de Ciencias de Cordoba, XIV, p. 381; Buenos Ayres, 1896.

tributions to the histories of both these orders, while other problems remain open.

In the paper of about 1060 pages now before us, M. Ameghino gives his views on the general subject. It seems that in his work Filogenia, published in 1884, he adopted the view of Gaudry of 1878, (previously barely suggested by others), that complex teeth of Mammalia are produced by the fusion of a number of originally distinct simple teeth; a view which has been supported by Kükenthal and Röse on embryologic grounds. It had been previously believed that additional cusps are the product of plications of the dental crowns of simple teeth, and in 1873 and later I had constructed on that basis a phylogenetic system of dentition. This, as is well-known, proceeds from the simple to the complex, without the element of fusion entering at any point. The series is, for the upper jaw; the haplodont, triconodont, tritubercular,[2] (sectorial) quadritubercular, quinque- and sextubercular, and the various lophodont forms; for the lower jaw; haplodont, triconodont, tritubercular, tuberculosectorial, (sectorial), quadritubercular, and the various lophodonts. This succession corresponds with the time order both in North America and Europe, and it is to be supposed that it must, therefore, do so in other parts of the earth, wherever the Mammalia have developed a dentition beyond primitive types.

I have never attempted to bring into this system the Monotrematous Prototheria, and have maintained that they constitute a distinct phylum.[3] My discovery that the dentition of the Permian Cotylosaurian family of the Pariotichidæ consists of simple teeth arranged in transverse series,[4] induced me to remark[5] "that the only question that could arise" as to the hypothesis of dental fusion "is with regard to the Multituberculata." A fusion of the teeth of the Pariotichidæ could produce molars like those of the Multituberculata; but there is no evidence that such a fusion has ever occurred.

Returning to the Eutherian Mammalia, we observe that Ameghino believes that the complex molars have preceded the simple ones in the order of time, and that the tritubercular molar is the result of a loss of a tubercle of the quadritubercular; the quadritubercular the result of

[2] Rütimeyer used the term trigonodont for triangular molars, without specification of the number of tubercles. This word cannot take the place of tritubercular, since the evolution is a question of tubercles, and not of shape. Some tritubercular teeth are quadrangular (Periptychus) and vice versa.

[3] See Amer. Journal of Morphology, 1889, p. 146.

[4] Proceeds. Amer. Philos. Society, 1895, 439–444.

[5] Primary Factors of Organic Evolution, 1896, p. 334. AMER. NATURALIST, 1896, Plate VIIa, p. 801.

reduction of a still more complex molar. Most of the evidence for this conclusion is derived from the fact, as he believes, that the Mammalia of Eocene and possibly earlier age, which are found in Argentina generally, have quadritubercular molars. In accordance with this view Cetacea and Edentata with numerous teeth, present a primitive type of dentition which has survived.

The reply which can be made to this fundamental proposition as to time-order, is, that M. Ameghino has probably affixed too great an age to his earlier beds. This is the opinion of Lydekker, and such extinct types as occur in those beds which occur elsewhere confirm this conclusion. Thus the Patagonian, which Ameghino regards as an Eocene formation, containing the Pyrotherium, contains also the primitive monkeys Anthropops, and the cetaceous Prosqualodon, Argyrocetus and Diaphorocetus. Now Diaphorocetus and forms closely allied to Arygocetus and Prosqualodon are characteristic of the middle Miocene in North America and Europe. It is highly improbable that the quadrumanous genera discovered by Ameghino are of Eocene age, since nothing of the kind occurs in Eocene beds in the Northern Hemisphere, where more primitive and ancestral lemuroid families represent them. The presence of supposed Condylarthra (not yet described) however, gives an Eocene character, and if the forms described by Ameghino as Multituberculata are really such, this character would be difficult to deny. However, recently Ameghino has recognized that these forms do do not belong to that order, but are true Marsupialia, and Lydekker assert that they do not belong to the Patagonian formation, but to the overlying Santa Cruz beds.[6] But supposing that the Patagonian formation is upper Eocene, it does not furnish the material for an elucidation of the dental characters of the primitive Mammalia. These are only partly displayed in the lower Eocene, for it is in the Postcretaceous (Puerco and Laramie) that the true ancestral relation of the tritubercular molar is fully seen. These formations may be represented by the lower or dinosaurian beds which lie below the Patagonian formation in Argentina, but no Mammalian remains have been found there thus far by Ameghino. The oldest Mammal is said to be the Pyrotherium of the Patagonian formation, but it has an aspect more modern than Eocene. It is suspected by Ameghino to be a proboscidian, but it has not yet been shown that it is not a marsupial.

Dr. Ameghino misinterprets North American fossils in more than one instance. He cites the Amblypoda in evidence of the proposition that the tritubercular molar is the result of a reduction of the quadri-

[6] Geographical History of Mammals, 1896, 115. Ameghino makes the same statement in Enum. Synopt. Mamm. Foss. Eocene de Patagonie, 1894, p. 10.

tubercular. His series is Uintatherium, Coryphodon, Pantolambda; the last the most completely tritubercular. The time order is, however, the reverse, viz.: Pantolambda (Puerco), Coryphodon (Wasatch, and Uintatherium (Bridger); the first the most unmodified tritubercular.

In accordance with his general position Dr. Ameghino believes (p. 72) that the quadritubercular genus Procyon is of great antiquity and prior to tritubercular types. This, however, cannot be believed. It has descended from a primitive plantigrade tritubercular, canine type, as have their allies the bears. The same modification is seen in the Mustelidæ in the badgers; and all such are modern forms. He states (p. 26) that in Periptychus and Mioclænus, Phenacodus and Achænodon, the teeth are quadritubercular. The first two genera have tritubercular molars with insignificant rudiments of others both before and behind the protocone (Periptychus) or behind only (Mioclænus), and they belong to the primitive Puerco period. The other two genera are quadritubercular, but belong to later beds, Phenacodus being Wasatch, and Achænodon, Bridger, neither of which formations has any genus in common with the Puerco (except Didymictis of Puerco and Wasatch ages).

Dr. Ameghino believes the Typotherian suborder of the Toxodontia to be related to the Quadrumana. The digits resemble decidedly those of that suborder, but one important difference is overlooked by him. He has pointed out the striking alternation of the two rows of carpal bones in the Typotheria, in which they agree with the Toxodontia proper, and with the Amblypoda. Now in primitive Quadrumana this alternation does not exist, but the bones of the two carpal rows, like those of the tarsus, are directly juxtaposed, or taxeopodous. This characterizes the Condylarthra, which furnish the exact foot characters of the lemuroids, or ancestral Quadrumana.

Finally as to Dr. Ameghinos' views of the origin of the Cetacea, he again inverts the order of succession. He does this by assuming that the Archæoceti are not related to the Cetacea proper, and cannot be ancestral to them. He does not regard the presence of two rooted molars in the fœtal Balæna as significant in this direction. The opinion of zoologists and paleontologists has been different from this, and I have confirmed the general view in my recent researches on the extinct Balænidæ of the Eastern United States.[7] I have shown that a decided sagittal crest like that of the Zeuglodontidæ exists in some of the Miocene whalebone whales. In my estimation the simple teeth of many Cetacea are the result of a process of dental degeneration.

[7] Proceeds. Amer. Philos. Soc., 1895, p. 139; 1896, p 141.

Their increase in number has not been due to subdivision of primitive teeth as supposed by Kükenthal, nor is it a survival of primitive conditions, as supposed by Ameghino, but it is probably a repetition of similar structures due to an extension of the dental groove and dental lamina, following the gradual elongation of the maxillary and premaxillary bones, proceeding contemporaneously with degeneracy of the teeth themselves.—E. D. COPE.

Eozoon canadense.—In recent numbers of the *Geological Magazine*, Dr. Dawson cites the evidence to date for the animal nature of Eozoon. Briefly summarized, the facts are these: (1) The rocks of the Grenville series, where the fossil in question occurs most abundantly, belong to a sedimentary formation. (2) They form a great calcareous system comparable with the metamorphosed Paleozoic calcareous beds of organic origin in petrological and chemical character. (3) New material showing more plainly the structure of the canal systems and tubes, evidences a definite plan of macroscopical structure. (4) Late discoveries of Archaeospherinae and other objects supposed to be organic in pre-Cambrian rocks in Canada and in Europe afford, to some extent, corroborative evidence in favor of Eozoon. (Geol. Mag. 1895.)

Thickness of the Coal Measures.—According to Mr. J. C. Branner, the total thickness of the Coal Measures (Pennsylvanian) sediments in Arkansas is greater than that of the sediments of the same age in other parts of the country or of the world. He gives the following table of comparison: Arkansas, 23,780 feet; Nova Scotia, 16,000 feet; Utah and Nevada, 16,650 (?) feet: Indian Territory, 10,000 feet. Mr. Branner finds a reason for the great thickness in the drainage of the Continent during Carboniferous times. "The rocks of this series in Arkansas afford fossil evidence that this part of the Continent was probably not much above tide level. The drainage from near the Catskill Mountains in New York flowed south and west. The eastern limit of the basin was somewhere near the Archean belt from New England to central Alabama. This Appalachian water shed crossed the present channel of the Missouri from Central Alabama to the Ouachita uplift, and the drainage flowed westward through what is now the Arkansas Valley, between the Ozark Island on the north and the Arkansas Island on the south." (Amer. Journ. Sci., Sept., 1896.)

Geological News.—PALEOZOIC.—An accumulation of fresh material from the Ichthyologic fauna of the Cleveland Shales, Loraine County, Ohio, has enabled Mr. C. R. Eastman to determine the rela-

tions of certain body-plates in the Dinichthyids. These are the median ventral plates of Titanichthys, and a postero-dorso-lateral of Dinichthys. The author further states that "every plate present in the body armor of Coccosteus has its representative in Dinichthys, and that the conditions of overlap and underlap are the same in both forms. (Amer. Journ. Sci., July, 1896.)

Cenozoic.—Mr. H. W. Fairbanks states that the Lower Cretaceous age is represented in Santa Barbara County, California, by the Knoxville beds, containing the characteristic Aucella fossils. This is the southern point at which the genus Aucella has been found in California. (Bull. Dept. Geol. Univ. Calif., Vol. II, 1896.)

The skull of *Orycteropus gaudryi* (Ant-Bear or Aard-Vark) from the Lower Pliocene of Samos, described by C. W. Andrews, indicates an animal about one-fifth less than the living species. The close resemblance between the fossil and recent forms is remarkable. Dr. Forsyth Major has pointed out that the former distribution of the genus indicates its northern origin, and that it spread into Africa along with the rest of the Pliocene Mammalia with which it has been found. (Proceeds. Zool. Soc. London, 1896.)

In discussing the geographical distribution of the known Castoroid species, Mr. Merriam notes that the American Castorinae seem to reach their maximum development at or before the beginning of Pliocene time, while the culmination of the Eurasia group appears to occur in the Pliocene. This apparent earlier culmination of the American Castorinae, together with the earlier extinction of certain forms in this country, seem to point to an American rather than to the European origin of the family. (Bull. Dept. Geol. Univ. Calif., 1896.)

According to Dr. Shufeldt, Harpagornis, the fossil bird recently found in New Zealand, represents a more or less aquiline type, that might easily have been the common ancestor to a number of genera of existing modern eagles, as, for example, Haliaetus, Aquila and Thalassaetus. A natural scheme of classification would place it between the genera Aquila and Thalassaetus. (Trans. New Zeal. Inst. [1895], 1896.)

ZOOLOGY.

Fishes in isolated pools.—The occurrence of fishes in pools which have no communication with running streams or large bodies of water has been often noticed, and the explanation of their origin and persistence in such places is in some cases not satisfactory.

In collecting during this month (September) in Camden county, New Jersey, I made the following observations. I fished near Winslow, a pool of about twenty-five feet in diameter, and two feet in depth, with a muddy bottom and a few Nymphæas growing in it. It is distant about a quarter of a mile from an insignificant ditch with a little running water, and is surrounded by higher and sandy ground, offering no possible communication with the ditch. A half mile distant and still more inaccessible is a running stream. From this pool I caught large numbers of the following fishes. *Umbra pygmæa, Apomotis obesus* and *Acantharchus pomotis.* The Acantharchi were small, while the others were fully grown.

A quarter of a mile distant from this pool, and at an equal distance from the ditch above mentioned, and not connected with it by any depression of the surface, is another pool of about thirty feet in diameter. The water reaches a depth of three feet in a limited portion of it, and Nymphæas are more numerous, together with Utricularia, etc. Here I obtained the following fishes in considerable numbers. *Umbra pygmæa, Amiurus prosthistius, Esox vermiculatus, Aphododerus sayanus, Apomotis obesus, Mesogonistius chaetodon, Acantharchus pomotis.* Many of these were fully grown. The turtle *Chrysemys picta* was also abundant.

The mud in the first mentioned pool was light colored, and all the fishes were remarkable for the extreme paleness of their tints. The second pool is situated in better soil and its mud contains much decomposing vegetable matter, and is consequently black. The fishes were all deeply pigmented, including the three species found in the other pool, from which they could be distinguished at a glance. The smaller pool was said to have been dried up during the past summer.

Seven additional specimens of the *Amiurus prosthistius* Cope enable me to verify the characters already given (Proceeds. Acad. Nat. Sci., Philada., 1883, 133), from an examination of four from the Batstow River, New Jersey. In five of the new specimens where I counted the anal rays, they number 26. Prof. Jordan has recently attempted to

identify the species with his *A. erebennus* in The Fishes of North and Middle America, 1896, p. 139. From Jordan's descriptions it is evident that the *A. prosthistius* is nearer to the *A. natalis* than to the *A. erebennus*. The spines are not elongated as in the former, nor is the head long and narrowed forward, but it is short and wide; it enters the length (without caudal) 3½ times and not four times. The mouth is relatively wider in the *A. prosthistius*, being .66 of the head-length, and not .5 of it as in *A. erebennus*. The inferior barbels are white in the former, while one may suppose they are black in the *A. erebennus* from Jordan's description. The supraoccipital spine is widely separated from the dorsal spine. In the specimens from Winslow the anal fin is relatively longer than in those from Batstow; in the former it enters the length (without caudal fin) very little over three times (3.2), while in the latter it enters from 3.5 times in one, to 3.66 in two, and 3.85 in another. The length of the anal rays is .66 of that of the head in the Winslow specimens, and .5 of the head in the Batstow specimens. The latter are of larger size.—E. D. Cope.

On the Mud Minnow (Umbra pygmaea) as an air breather.—In the autumn of 1895, I tried to keep a few fishes alive in a small aquarium, viz., a glass jar holding about a gallon. This was filled with well water and some water plants placed in it which grew well. Various fish were placed in it from time to time but all without exception died in less than six hours except a Mud Minnow (*Umbra pygmæa*) This came to the top at frequent intervals, on each occasion emitting bubbles of air and presumably gulping more down, making considerable noise in so doing. On being placed in well aerated water six weeks or more later, this habit ceased.

The other fishes which were placed in the jar, Catfishes, Minnows, Sunfish, and Suckers would come at once to the top gasping for air, and died in an hour or two.

I have placed other of these fish—*Umbra pygmæa*, in well water and they acted the same way, coming to the top at frequent intervals and "bubbling" each time.

I have never found any of these fish dead in dried up pools, though I have carefully looked for them, presumably their ability to use air for respiration saves them.—C. S. Brimley.

The Peritoneal Epithelium in Amphibia.—In a recent study of the peritoneal ephithelium in Amphibia the following points were noted. The species examined were *Necturus maculatus, Amblystoma punctatum, Desmognathus fusca* and *Diemyctylus viridescens*. All the

specimens of *Necturus*, *Desmognathus* and *Diemyctylus* were taken from January to April and none were examined after spawning. Specimens of *Amblystoma* were studied shortly before and immediately after ovulation, and in August and December. In all the species cilia were found only in the adult female. They occurred constantly upon the hepatic ligament, the ventral wall of the body cavity, the membranes near the mouths of the oviducts and upon the serosa of the liver. In *Amblystoma* cilia were also found upon the mesoarium and the membranes supporting the oviducts. Some of the adult female *Necturi* possessed cilia also upon the cephalic part of the dorsal wall of the body cavity. The ciliated cells occured either singly or in groups. They were most numerous near the mouths of the oviducts. It was found that the direction of the current produced by the cilia was towards and into the mouths of the oviducts. This and the fact that cilia are present upon the peritoneum of the adult female only would seem to strengthen the theory that the ova when set free in the body cavity are propelled by means of cilia into the oviducts.—Isabella M. Green.

The Penial Structure of the Sauria.—In the Proceedings of the Philadelphia Academy for August and September I have published a paper on this subject, which gives the results of an investigation into the anatomy of the hemipenes of lizards. Very little attention has been given to the subject hitherto, and our knowledge up to 1856[1] is thus summarized by Stannius: " A duplication or bifurcation of each organ is present in *Lacerta* and in *Platydactylus guttatus*. The copulatory organs of the Chamæleonidæ are distinguished by their shortness. In various Varanidæ which have been investigated the internal cavity (external when protruded) has transverse concentric folds. A fissure interrupts these folds so that they are not complete annuli. The extremity is acuminate and expands at the base, forming a kind of glans."

In 1870[2] J. E. Gray describes and figure this organ of *Varanus heraldicus*, giving the best illustration that I know of. In 1886 Wiedersheim (Lehrbuch der Vergl Anat. Wirbelth.) describes and figures this organ in Lacerta. Besides these references I know of nothing later.

As was to have been anticipated, I have found these organs to correspond with the rest of the structure, and to furnish invaluable aids to the determination of affinities among the Sauria. Reference to them

[1] Zootomie der Amphibien, p. 266.

[2] Annals Magaz. Nat. Hist., 1870, VII, p. 283.

cannot be omitted henceforth in cases where the other characters render the question of affinity uncertain.

In the Sauria the male intromittent organ or hemipenis, presents much variety of structure, showing some parallels to the corresponding part in the snakes. It is, however, rarely spinous, as is so generally the case in the Ophidia, the only spinous forms being, so far as I have examined, the American Diploglossinæ and genera allied to *Cophias*. The higher Sauria have the apical parts modified, as in the Ophidia, by the presence of calyculi. Such are characteristic of the Rhiptoglossa and Pachyglossa. The Nyctisaura possess the same feature. The Diploglossa, Helodermatoidea and Thecaglossa have the organ flounced, the flounces often pocketed or repand on the margin. In the Leptoglossa we have laminæ only; in the Tiidæ mostly transverse, and in the Scincidæ mostly longitudinal. In various genera terminal papillæ are present. The organ may be simple or bifurcate or merely bilobate. I have not met with the case so common in the Ophidia, where the sulcus spermaticus is bifurcate and the organ undivided.

The structures of the hemipenis have a constant systematic value. As in the Ophidia, the value differs with the character, but it varies from generic to superfamily in rank.—E. D. Cope.

Food habits of Woodpeckers.—A preliminary report on the food habits of Woodpeckers has been published by F. E. L. Beal, the assistant ornithologist in the U. S. Dept. of Agriculture. The paper is based on the examinations of 679 stomachs of Woodpeckers, representing 7 species—all from the eastern United States. The results of the author's investigations are summarized as follows:

"In reviewing the results of these investigations and comparing one species with another, without losing sight of the fact that comparative good is not necessarily positive good, it appears that of 7 species considered the Downy Woodpecker is the most beneficial. This is due in part to the great number of insects it eats, and in part to the nature of its vegetable food, which is of little value to man. Three-fourths of its food consists of insects, and few of these are useful kinds. Of grain, it eats practically none. The greatest sin we can lay at its door is the dissemination of poison ivy."

"The Hairy Woodpecker probably ranks next to the Downy in point of usefulness. It eats fewer ants, but a relatively larger percentage of beetles and caterpillars. Its grain eating record is trifling; two stomachs taken in September and October contained corn. For fruit, it seeks the forests and swamps, where it finds wild cherries, grapes, and

the berries of dogwood and Virginia Creeper. It eats fewer seeds of the poison ivy and poison sumac than the Downy."

"The Flicker eats a smaller percentage of insects than either the Downy or the Hairy Woodpecker, but if eating ants is to be considered a virtue, then surely this bird must be exalted, for three-fourths of all the insects it eats, comprising nearly half of its whole food, are ants. It is accused of eating corn, but its stomach yielded only a little. Fruit constitutes about one-fourth of its whole fare, but the bird depends upon nature and not upon man to furnish the supply."

"Judged by the results of the stomach examinations of the Downy and Hairy Woodpecker and Flicker it would be hard to find three other species of our common birds with fewer harmful qualities.

The Ectal Relations of the Right and Left Parietal and Paroccipital Fissures.—A preliminary communication upon this subject was made by Dr. B. G. Wilder at the last session of the American Neurological Association in Philadelphia.

The following abstract presents the salient points of the paper:

"The parietal and paroccipital fissures may be either completely separated by an isthmus, or apparently continuous. When so continuous ectally there may still be an ental and concealed vadum or shallow. Disregarding the vadum on the present occasion, the ectal relations of the two fissures may be designated as either *continuity* or *separation*. That continuity occurs more frequently on the left side has been noticed by Ecker, Cunningham and the writer. Hitherto, however, statistics have included unmated cerebrums as well as mates from the same individuals. The following statement is based upon the cerebrums of 58 adults of both sexes and various nationalities and characters. The speaker has examined 48; the other ten have been accurately recorded by Bischoff, Dana, Jensen and Mills."

"The four possible combinations of right and left continuity and separation occurred as follows."

"I. Left continuity and right separation in 27 ; 46.5 per cent.

II. Right and left continuity in 22 ; 38 per cent.

III. Right and left separation in 8 ; 13.8 per cent.

IV. Left separation and right continuity in 1 ; 1.7 per cent."

"When five groups of persons are recognized the combinations are as follows:

A. In 8 moral and educated persons, combination I, 62.5 ; II, 25 ; III, 12.5.

B. In 23 ignorant or unknown I, 56.5 ; II, 34.8 ; III, 8.7.

C. In 20 insane, I, 40; II, 35; III, 20; IV, 5.
D. In four murderers, I, 0; II, 75; III, 25.
E. In three negroes, I, 33; II, 67.

So far as these 58 individuals are concerned, the most common combination, viz., left continuity and right separation, is decidedly the rule with the moral and educated, less frequent with the ignorant and unknown, the insane and negroes, and does not occur at all in the murderers. The only instance of the reverse combination (left separation and right continuity) is an insane Swiss woman. The only two known to be left-handed presented the more frequent combination I. (Journ. Comp. Neurol. Cincinnati, Vol. VI, 1896.)

PSYCHOLOGY.[1]

The Nature of Feeling.—A cardinal point of dispute in current psychology is the nature of feeling. The division of simple feeling into pleasure and pain is generally accepted; the question that remains unsettled is the relation of these latter to sensation. Wundt, Lehmann, Marshall and other recent writers, whose views differ in important respects, agree in regarding pleasure-and-pain as a characteristic of sensation (its *Gefühlston*) like quality or intensity. On the other hand there are those who claim that pain (at least) is a separate species of sensation, with a distinct set of nerves and end-organs. Goldscheider at one time believed that he had discovered these pain nerves, but he has recently retracted this claim. Others, again, regard pain as an extreme form or quality of sensation common to the touch, heat and cold senses.

The problem is somewhat complicated by the ambiguity of the word *pain*. In the sense of "physical pain" (*Schmerz*) it may be a species of sensation; while at the same time in the sense of "displeasure" (*Unlust*) it may be regarded as either an "attribute" of sensation or a second element of consciousness. This distinction is maintained by Münsterberg and Baldwin, among others.[2] The ordinary associations of the word *pain* have undoubtedly biased many writers and helped to keep alive the confusion between its two meanings.

[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.

[2] Dr. Nichols in his criticism of Baldwin in the September number of this magazine certainly misapprehends the latter's view on this point. Cf. Mental Development, pp. 483, f.

Prof. Titchener in treating of the subject in his Psychology[3] endeavors to avoid this ambiguity by discarding the terms pleasure and pain, and using *pleasantness* and *unpleasantness* instead. Apart from his terminology, Prof. Titchener's discussion is of special interest from the fact that, although an earnest follower of Wundt in most respects, he recognizes feeling or affection, as a distinct element of consciousness. Wundt reduces all consciousness (aside from the active) to a single element, sensation; Prof. Titchener restricts sensation to the cognitive side of consciousness, and makes affection a distinct and co-ordinate term.

The mind, or consciousness, he says, "not only senses: it *feels*. It not only receives impressions and has sensations: it receives impressions in a certain *way*. . . . Life means the balance of power (more or less effective) in the perpetual conflict of two opposing forces—growth and decay. No impression can be made upon the living body that does not tend in some way to change this balance. . . . It must help either to build up nervous substance or to break it down. The organism is a whole: and what effects it in either of these ways at one part, must affect it as a whole, in all. The conscious processes corresponding to the general bodily processes thus set up by stimuli—processes not confined to definite bodily organs—are termed *affections*. . . . There are only two bodily processes to give rise to affective processes: the building-up process (anabolism) and the breaking-down process (catabolism). We should expect, then, to find no more than two qualities of affection; and introspection tells us that expectation is correct. The anabolic bodily processes correspond to the conscious quality of *pleasantness*, catabolic processes to that of *unpleasantness*."

Prof. Titchener then examines the relation of affection to sensation. "The processes of pleasantness and unpleasantness seem, at least in many cases, to bear a strong resemblance to certain concrete experiences which we have analyzed, provisionally, as complexes of sensations. Thus pleasantness may suggest health, drowsiness, bodily comfort; and unpleasantness pain, discomfort, overtiredness, etc. . . . Now there can be no doubt of the resemblance in the instances cited. But the reason of it is simply this, that health, drowsiness and bodily comfort *are* pleasant, *i. e.*, that pleasantness is one of the constituent processes, running alongside of various sensation processes, in the total conscious experience which we call 'health,' etc.; and that pain, bodily discomfort and overtiredness *are* unpleasant, *i. e.*, that unpleasantness is one of the processes contained in each of these complex experiences.

[3] An Outline of Psychology, by E. B. Titchener, Chap. V.

Beyond this there is no resemblance: a sensation process is radically different from a pleasantness or an unpleasantness." This difference appears in several ways:

(1). The sensation is looked upon as belonging to the object which gives rise to it, while the affection is regarded as belonging to the subject or conscious self. "Blue seems to belong to the sky; but the pleasantness of the blue is in me. Warmth seems to belong to the burning coals; but the pleasantness of warmth is in me. . . . The distinction is unhesitatingly drawn in popular thought, and clearly shown in language. It points to a real difference between sensation and affection as factors in mental experience—a difference which the psychologist must make explicit in his definition of the two processes. The same difference is observed even when we compare the affective processes with those sensations which are occasioned from within, by a change in the state of the bodily organ. The unpleasantness of toothache is far more personal to me than the pain of it. The pain is 'in the tooth;' the unpleasantness is as wide as consciousness."

(2). If a stimulus be long continued, the affection, if it is not of such a character as to pass over into pain, in the end becomes indifferent, while the sensation remains as strong and clear as ever, when the attention is directed to it. "Nervous substance, at the same time that it is very impressionable, is eminently adaptable. The organism adjusts itself to its circumstances—resigns itself, so to say, to their inevitableness. When once adaptation or adjustment to surroundings is complete, the surroundings cease to be taken either pleasantly or unpleasantly; their impressions are simply received, passively and unfeelingly."

(3). "The more closely we attend to a sensation, the clearer does it become, and the longer and more accurately do we remember it. We cannot attend to an affection at all. If we attempt to do so, the pleasantness or unpleasantness at once eludes us and disappears, and we find ourselves attending to some obtrusive sensation or idea which we had no desire to observe."

(4). "As a general rule, 'central' sensations are much fainter and weaker than 'peripheral.' A remembered noise has hardly anything of the intensity of the noise as heard. Affection can originate in the same two ways. But 'central' pleasantness and unpleasantness are not only as strong as—they are in very many cases stronger than —'peripheral.'"

"We see, then," concludes Prof. Titchener, "that there are strong reasons for regarding affection as different from sensation. It must be

carefully noted that the statements just given of these reasons do not tell us *how* 'red,' a sensation, differs from 'pleasantness,' an affection, in mental experience. They are sufficient indication that a real difference exists; but the difference itself cannot be described—it must be experienced."

It remains to be seen how this theory, or rather Prof. Titchener's restatement of it, will be met by the adherents of the Wundtian view. As to the verbal innovation, the terms *pleasantness* and *unpleasantness* would be more welcome if the proposed meanings accorded better with ordinary usage. Both words, especially the second, are suggestive of a very mild form of feeling; and until we became accustomed to the change it would excite our sense of the ludicrous to call the feeling connected with a violent toothache or an intense abdominal pain *unpleasant.*—H. C. WARREN.

Further Comments on Prof. Baldwin's "New Factor in Evolution."—In a "Note" in THE AMERICAN NATURALIST, October, 1896, Prof. Baldwin declares that I have grossly misunderstood his views, and that, to quote his words, "Dr. Nichols' home thrusts are all directed at my view of pleasure and pain, which he considers, quite mistakenly, the point of my paper. On the contrary, the 'factor' is entirely the influence of the individuals adaptation on the course of evolution; not at all the particular way in which the individual makes its adaptation."

This quotation is typical of the author's style of thinking and writing; of which his critics unanimously complain. The word "influence" is frequently misused by careless writers, as in the above, to denote the *results* of a factor, rather than the factor itself. A "factor" is a set of influences or circumstances contributing *to produce* a result. It is true that an author, if of expansive mind, may run ahead of his subject. It is true, as Prof. Baldwin above declares, that his mind was chiefly on the results supposed by him to be worked by his factor. But he should not forget that he declared himself, in his title, to be writing about his "new factor"; and it was quite correct that he should write about it, since one ought, in Science, to establish the existence of a thing before discussing its effects. It was this last I had in view when, in my paper, I directed my discussion toward demonstrating that his new factor, as specificly described by Prof. Baldwin, was a myth.

I directed my discussion against Prof. Baldwin's views of pleasure and pain because he completely identified his "factor" with his particular and all-expansive views of pleasure and pain. On p. 451 of his

pamphlet, he sums up his June paper in these words: "It seems proper, therefore, to call the influence of Organic Selection "a new factor; . . . . *The ontogenetic adaptations are really new, not performed; and they are really reproduced in succeeding generations, although not physically inherited.*" Here the author correctly, though in flat contradiction to his Note, declares in so many words his factor *to be* Organic Selection, and "ontogenetic adaptations" is for it but another name. Of this fact the words which he italicized leave no doubt. Naturally, to find out most accurately what Prof. Baldwin means by Organic Selection, we go to that part of his writing which most professedly expounds it. This is done in Part IV, p. 541, under the caption: "The Process of Organic Selection." After preliminary remarks, which I shall speak of later, Prof. Baldwin's exposition is in the following words:

"There is a fact of physiology which, taken together with the facts of psychology, serves to indicate the method of adaptations or accommodations of the individual organism. The general fact is that the organism concentrates its energies upon the locality stimulated, for the continuation of the conditions, movements, stimulations, which are vitally beneficial, and for the cessation of the conditions, movements, stimulations, which are vitally depressing and harmful. In the case of beneficial conditions we find a general *increase of movements, an excess discharge of the energies of movement in the channels already open and habitual; and with this as the psychological side, pleasurable consciousness and attention.* . . . This form of concentration of energy . . . is called the "circular reaction." It is the selective property which Romanes pointed out as characterizing and differentiating life. It characterizes the responses of the organism, however low in the scale, to all stimulations—even those of a mechanical and chemical nature— . . . Now, as soon as we ask how the stimulations of the environment can produce new adaptive movements, we have the answer of Spencer and Bain—an answer directly confirmed, I think, without question, by the study both of the child and of the adult, *i. e.*, by the selection of fit movements from excessively produced movements, that is, from *movement variations.* So, granting this, we now have the further question: How do these movement variations come to be produced when and where they are needed?"

Having reduced his problem of "the selection of fit movements," *i. e.*, of Organic Selection, to this pointed inquiry, Prof. Baldwin then proceeds to state his still more explicit exposition of his selective "factor" in full, as follows:

"But, as soon as we inquire more closely into the actual working of pleasure and pain reactions, we find an answer suggested [an answer to the last above quoted question]. The pleasure or pain produced by a stimulus—and by a movement also, for the utility of a movement is always that it secures stimulation of this sort or that—does not lead to diffused, neutral, and characterless movements, as Spencer and Bain suppose; this

is disputed no less by the infants movements than by the actions of unicellular creatures. There are characteristic differences in vital movements wherever we find them. There is a characteristic antithesis in vital movements always. Healthy, overflowing, overstretching, expansive, vital effects are associated with pleasure; and the contrary, the withdrawing, depressive, contractive, decreasing, vital effects are associated with pain. This is exactly the state of things which the theory of the selection of movements from over-produced movements requires, *i. e.*, that increased vitality, represented by pleasure, should give the excess movements, from which new adaptations are selected; and that decreased vitality, represented by pain, should do the reverse, *i. e.*, draw off energy and suppress movement.

"If, therefore, we say that here is a type of reaction which all vitality shows we may give it a general descriptive name, *i. e.*, the "Circular Reaction," in that its significance for evolution is that it is not a random response in movement to all stimulations alike, but that (it distinguishes etc.) it distinguishes in its very form and amount between stimulations which are vitally good and those which are vitally bad, tending to retain the good stimulations and to draw away from and so suppress the bad. . . . *This kind of selection, since it requires the direct co-operation of the organism itself, I have called Organic Selection.*"

"This" (note the last sentence), then, is the "Organic Selection" which Prof. Baldwin himself specifically declares (p. 451) he names a "new factor." As the reader must see for himself, the author's description of it is a description of pleasure-pain functions pure and simple and nothing more. It is not *merely* the old pleasure-pain tradition, for nothing remains inexpansive in this vigorous author's hands. But it is the orthodox tradition unfolded to "a type of reaction which all vitality shows;" which "distinguishes in form and amount between stimulations which are vitally good and those which are vitally bad;" "which is a characteristic antithesis in vital movements always;" which "is the selective property which Romanes pointed out as characterizing and differentiating life;" and which performs its task of the "*selection of fit movements*" generally, by its universal exercise in all creatures from first to last and at all times.

It is dangerous to grapple with an author who is so macrocosmic in his thought, and so amorphous in his diction. But I discussed Mr. Baldwin's "New Factor" from the point of view of his "expanded" pleasure-pain functions because he so completely *identified* it with them. I cannot conceive this to have been done more explicitly and completely than in the author's specific exposition of Organic Selection in his Part IV. Under this situation it was surely "to the point" to prove Mr. Baldwin's New Factor a myth. The tone of Mr. Baldwin's "Note" seems to indicate that this was done with peculiarly exhaustive effect.

A word remains to be said about Mr. Baldwin's complaint that his pamphlet distinctly insisted on *the fact* of Organic Selection, without regard to any "particular way" it may be accomplished. Prof. Baldwin did file such a caveat upon all possible ways which man may ever invent for proving that Organic Selection *may be* a fact. But this is not the method of Science. She does not feel called upon *to invent* all possible ways before she rejects the sole one offered. When Prof. Baldwin does give us some other "particular way" than the one he did give for the operation of his factor, I will, perhaps, then be able to show him it cannot be called "new" with any sort of justice to Darwin and to biologists commonly.

Of the personal tone of Mr. Baldwin's "Note" I have nothing to remark, save by way of gratification, that it is unmatched in American Science. HERBERT NICHOLS.

Boston, Oct. 14, 1896.

ANTHROPOLOGY.[1]

Pictured Caves in Australia.—In West Australia, New South Wales, Queensland, and doubtless in other parts of Australia, where the geology is favorable, rock shelters and caves have been recently noticed, whose walls are decorated with native allegorical designs and figures of men, birds and animals outlined in colour. Mr. T. Wornsop addressing the Australasian Association for the Advancement of Science at Brisbane in January, 1895 refers to a great number of rock paintings of Kangaroos, Lizards, Emus, Flying birds, Snakes and other forms. Refering to discoveries of these strange and impressively decorated shelters by Sir George R. Grey, Mr. Stockdale, Mr. O. Donnell and others, he states that a general similarity characterizes the designs wherever found, and describes further the curious method of painting generally noted, which appears to consist in smearing the rock surfaces with animal fat, pressing the object to be represented against the greased rock, and then blowing dry color against it so as to thus stencil the outlined form by a surrounding area of contrasting tint. When wet color was splashed on, no grease would have been needed. Mr. W. J. Enright, the discoverer of numerous painted caves and Mr. R. H. Matthews describe in particular the abundant figures of human hands with

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

out stretched fingers apparently painted and stenciled in this manner, often in red, in nearly all the caves. Along the Glen Lake river valley near Kimberly, West Australia and on Bulgar Creek, New South Wales the caves display hearts, white human figures on black backgrounds, staring faces outlined in red, with yellow lines, figures of the rising-sun, and Phallic symbols, where the stenciling according to Mr. Enright has often been done by blowing powered pipe clay from a deposit near at hand (sometimes white and sometimes stained yellow by oxides) upon the greased rock. Strangest sight of all must be the weird shelter on Nardo Creek in Central Queensland where a diabolical picture 70 feet long seems to represent a lake out of which are stretched hundreds of brown human arms pointing, grasping and knotted in many positions as if writhing in torture.

Mr. Wornsop and others looking in vain for a clue to the meaning of the rock paintings, have set in evidence the refusal of neighboring natives to account for them, just as earlier observers in America, were wont to quote indian ignorance of mounds, and earthworks. But on the other hand Mr. Enright noting the fresh appearance of many of the designs, speaks of one of the decorated caves recently inhabited by a native named Cutta Muttan, without doubting that the later had done the painting. No doubt he did, and small question that natives now living in Australia could if sympathetically approached by Ethnologists (who living with them had gained their confidence), explain all the designs. —H. C. Mercer.

Man and the Fossil Horse in Central France.—Not many hundred yards from the classic rock shelters of Laugerie Haute and Laugerie Basse (which contain according to the French classification *Magdalenian* and *Solutrean* culture layers) a recently exposed talus, along the Manaurie brook an affluent of the Vezere (department Dordogne Commune Tayac, France) has revealed an interesting and surprising deposit of human remains associated with bones of the fossil horse. M. M. Chauvet and Riviere digging a trench 17 meters long, 1.80 meters broad and 3 meters deep, found in one day, three hundred and more horse-teeth together with other horse bones generally broken by human hands, besides the remains of the badger (*Meles taxus*) and the canine tooth of a large carnivore. No fresh water or marine shells were found but with the bones about two hundred chipped flint axes ("Turtlebacks") of so-called Chellean type, or of similar ovate form worked only on one side, were unearthed in a few days, with three Mousterian *racloirs*, four discoidal flints, two Magdalanian flakes, two scrapers,

and some nuclei. But few details as to the stratification or formation of the deposit are given in the account published in Cosmos (Sept. 12, 1896, P. 211) and as nothing is said about hammer-stones, and flint chips, we are left to wonder whether the place represents a palæolithic workshop such as Messrs. Spurrel and W. G. Smith found at Crayford and Caddington, England or not. Meanwhile the excavation which we are told is to be continued, if studied with care and without bias may affect the validity of the French subdivisions (*Chellean Mousterian, Solutrean Magdalenian*) of the Palæolithic period in Central France. Judged by the shape of the flint blades found with the horse bones, M. M. Chauvet and Riviere call the deposit *Chello-Mousterian* while hardly a mile away, we have Laugiere Haute classified as showing *Magdalenian* above *Solutrean* culture layers, with Laugiere Basse, Cro-Magnon and Gorge d'Enfer floored with *Solutrean* only. The rock shelters of Le Moustier (*Moustierian*) and La Madeleine (*Magdalenian*) are not far distant and the question is whether all these different geological epochs supposed to indicate intervals of thousands of years, varying stages of human culture and changes in animal life can be justly established at this remarkable neucleus of ages where one more subdivision is proposed to be added to the list of culture layers represented in an area of a few square miles and based on differences in flint chipping, and variations not universally agreed to, in the sequence of animal life.

Chipped Flint blades from Somali Land.—Mr. H. W. Seton-Karr who presented to the British Association for the Advancement of Science at Ipswich, England in 1895 several heavy ovate blades of chipped flint from Somali Land, has brought more recently from the same region others (referred to in Proceedings of Royal Society, Vol. LX, no. 359, p. 19). Often well worked, considerably patenated, and resembling in shape and make, the drift blades of England and France they appear to have been found not in situ but on ths surface, mostly along water courses where rain or wind had bared them of surrounding earth. No excavations were made to ascertain their position with reference to the surrounding geological strata, and no association appears to have been established with the remains of animals living or extinct. Nothing is said of Hammer-stones or chips that might have testified to the existence of blade workshops at the sites, and nothing as yet save the appearance of the blades (some of which are worked only on one side after the French *Moustier* pattern) has been presented to warrant us in setting back the date of these relics to the date of the similar shapes associated with the Mammoth and Rhinocerus in the Somme Valley.

Cave Hunting in Scotland.—If as we understand no chipped blades of the "Turtleback" or drift character have been gathered in Scotland or northern Europe, if no traces of (Paleolithic) man in Association with the Cave Bear, Woolly Rhinocerus and Mammoth have been discovered in caves or quarries anywhere to the northward of middle England or in Scandinavia North Germany and Russia, if in a word it can be proved that snow and ice precluded human presence or obliterated man's foot-prints in northern Europe at the time when drift men were chipping flint on the banks of the Thames and Somme, then the exploration of caves in any part of this colder European region is of particular scientific interest. Near Oban in Scotland the Mackay, Gas works, Distillery, and MacArthur caves recently explored by Mr. J. Anderson for the Society of Antiquaries of Scotland (see proceedings of the Society, vol. XXIX, 1895, p. 211) showed human rubbish deposits consisting largely of the shells of edible mollusks (Ostrea, Patella, Pecten, Solen, etc.), interbedded in one instance (the Mackay Cave) with a gravel layer apparently caused by a marine inundation. In the latter cave, fairly representing the others, Mr. Anderson found in in the shell rubbish about 150 bone needles and points, seven numerously barbed bone harpoons, sometimes with pierced bases, three pebble hammerstones, a few flint nodules, and several flakes and scrapers together with numerous fish bones and the remains of the common deer, the *Bos longifrons*, boar, the dog and the cat; in other words, the recent fauna of the region. The bones of fifteen human skeletons found apparently near the surface and above the shell and bone refuse in the various caves, according to Mr. Anderson and Sir William Turner, represent a people of the Neolithic or late stone age in Europe, while on the other hand M. Boule (see L. Anthropologie, May and June, 1896, p. 321) citing the gravel bed as evidence of an early flood and comparing the barbed and pierced harpoons with similar harpoons supposed to be of an intermediate age (between Paleolithic and Neolithic) from certain French caves, suggests that the Oban remains form a connecting link between the Paleolithic (Mammoth, Rhinoceros and Reindeer time) and the Neolithic (recent fauna time) of western Europe. When all the results of European archæology are summed up it has been supposed that a hiatus in time unbridged by any intermediate human or animal presence, existed between the earlier and later of these periods, and a link will be added to the archæological chain, if discoveries in French caves or elsewhere satisfactorily fill the supposed gap. But whether the remains from Oban can or cannot be assigned this important intermediate position, further investigation will show. For a time the cave explorer might leave

the southern fields where much collaboration has perplexed the subject, and turn northward. There the coast is clear. There evidence broadening the perspective of the European student, and setting a wide geographical limit to the ancient human record, can be established in unexplored caves, where in a new way the unearthed testimony should show the relation of fossil man to glacial ice and cold.—H. C. MERCER.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—Biological Section, October 12, 1896.—Dr. Bashford Dean and Mr. G. N. Calkins presented preliminary reports upon the results attained at the Columbia University Zoological Laboratory at Port Townsend, Washington. The expedition spent about six weeks in exploring and collecting, and brought home large collections from exceptionally favorable collecting grounds. Dr. Dean spent some time in Monterey, Cal., and brought home collections of eggs and embryos of Chimæra and Bdellostoma.

Dr. J. L. Wortman made a preliminary report upon the American Museum Expedition to the Puerco and Wasatch Beds. He reported finding a connecting link between the close of the Cretaceous and the beginning of the Tertiary. He gave an interesting account of the massive ruins of the so-called cliff-dwellers in the region visited by him. In the Big Horn basin the expedition had remarkable success as well as in the Wind River basin.

Prof. Osborn stated that with the collections made this summer the American Museum could now announce that their Eocene collection was complete, containing all mammals now known in the Eocene; that their collection from the Wasatch bed was the finest in existence, and that from the Wind River basin was complete; the Bridger was represented by all but two or three types; and fine collections have been made in the Uintah.

Mr. W. J. Hornaday made a report of a tour of inspection of foreign zoological gardens, made under the auspices of the New York Zoological Society. He visited fifteen gardens in England and on the continent, studying the features of excellence in each.

Prof. Bristol gave a brief account of the progress at the Marine Biological Laboratory at Wood's Hole, Mass., during the past summer.

Prof. Osborn offered the following resolution on the death of Professor G. Brown Goode, after paying a tribute to his memory:

Resolved, That the members of the Biological Section of the New York Academy of Sciences desire to express their deep sense of loss in the death of Professor G. Brown Goode, of the U. S. National Museum. In common with all naturalists in this country, we have admired his intelligence and highly successful administration of the National Musuem as well as his prompt and ready response to the requests and needs of similar institutions throughout the country.

In face of the arduous and exacting duties of his directorship he has held a leading position among American zoologists, and we are indebted to him for a series of invaluable investigations, especially upon the fishes.

Those of us who had the good fortune to know Professor Goode personally, recall his singular charm of character, his genial interest in the work of others, his true scientific spirit. We have thus lost one of our ablest fellow-workers and one of the truest and best of men.

The resolution was adopted unanimously by a rising vote.

CHARLES L. BRISTOL, *Secretary.*

The Academy of Science of St. Louis.—At a meeting of the Academy of Science of St. Louis, held October 19, 1896, Mr. Trelease exhibited living flowers of *Catasetum gnomus*, demonstrating the extreme irritability of their tentacles and the precision with which the pollinia become attached to any object touching either tentacle. Mr. J. B. S. Norton presented a list of the Ustilagineæ of Kansas, together with the result of germinations of about one-half of the entire number. Three persons were elected to active membership.

WILLIAM TRELEASE, *Recording Secretary.*

The Biological Society of Washington.—The following communications were made: C. Hart Merriam, "A New Fir from Arizona;" Frederick V. Coville, "Notice of Britton and Brown's Illustrated Flora of the Northern United States and Canada;" Erwin F. Smith, "A Bacterial Disease of Potatoes, Tomatoes and Eggplants;" B. E. Fernow, "Timber line: Its Aspects and Causes."

FREDERICK A. LUCAS, *Secretary.*

SCIENTIFIC NEWS.

A course of eight free lectures mainly upon Science and Travel has been arranged by the Field Columbian Museum for Saturday afternoons in October and November at the usual hour, 3 o'clock. Most of these lectures will be illustrated by steropticon views. Subjects, Dates and Lecturers: Oct. 3.—"Archeological Explorations in Peru," Dr. G. A. Dorsey, Assistant Curator of Anthropology, Field Columbian Museum. Oct. 10.—"A Trip to Popocatapetal and Ixtaccihuatl," Prof. O. C. Farrington, Curator of Geology, Field Columbian Museum. Oct. 17. —"San Domingo," Mr. G. K. Cherrie, Assistant Curator of Ornithology, Field Columbian Museum. Oct. 24.—"Egypt and what we know of her," Dr. J. H. Breasted, Instruction in Egyptology and Semitics, University of Chicago. Oct. 31.—"The Petroleum Industry," Dr. D. T. Day, Chief of Division of Mineral Resources, U. S. Geological Survey. Nov. 7.—"Alaska and its Inhabitants," Prof. George L. Collie, Beloit College, Wis. Nov. 14.—"The Economic Geology of the Sea," Mr. H. W. Nichols, Curator of Economic Geology, Field Columbian Museum. Nov. 21.—"The Physical Geography of New England," Dr. H. B. Kümmel, Assistant Professor of Physiography, Lewis Institute.

Dr. Ludwig Reh, formerly assistant in the Museum at Saõ Paulo, Brazil, has been appointed assistant in the Concilium Bibliographicum at Zürich. With this addition to the working force the Bureau will soon bring its work up to date; and its cards will be sent out more frequently than before.

The annual meeting of the American Psychological Association will be held at Boston, December 29th and 30th, 1896, that place and time having been chosen by the American Society of Naturalists and ratified by the President of the Association.

The Executive Committee of the American Society of Naturalists have decided to hold the next meeting of the Naturalists at Boston and have chosen the Inheritance of Acquired Characters for the theme of discussion.

The next session of the Association of American Anatomists shall be held in Washington City, May, 1897, in conjunction with the other societies of the Congress of American Physicians and Surgeons.

J. H. Maiden has been appointed government botanist and director of the botanical gardens of New South Wales, succeeding Charles Moore who held the position for nearly fifty years.

Mr. F. F. Blackman has been appointed assistant in botany in the University of Cambridge, and Dr. E. Albrecht assistant in the Anatomical Institute of the University of Munich.

The Academy of Natural Sciences of Philadelphia has conferred the Hayden Memorial Geological Award for 1896 on Prof. Giovanni Capellini of the University of Bologna.

Prof. A. N. Kuznetzow has been advanced to the position of ordinary professor of botany and director of the botanical gardens in the University of Dorpat.

The Ninth Annual Winter Meeting of the Geological Society of America will be held in the city of Washington, D. C., on December 29, 30, 31, 1896.

Dr. H. Hanns, Th. Loesener and P. Gräbner have been called as scientific assistants to the botanical museum of the University of Berlin.

Dr. L. Kathariner, of Würzburg, goes to the professorship of zoology and comparative anatomy in the University of Freiburg, Switzerland.

Dr. V. Schiffner has been advanced to the position of professor extraordinarius of botany in the German University of Prague.

Dr. A. Möller, of Idstein, well-known for his studies of South American botany has gone to the Forestry Academy at Eberswald.

The Ministry of Education has conferred the title of professor upon the botanist Dr. Kienitz-Gerloff, of Weilberg on the Lahn.

Dr. B. Hofer, of the University of Munich, has been appointed professor of fish culture in the Veterinary school at Munich.

Dr. K. Busz, formerly of Marburg, has gone to the University of Munich as extraordinary professor of mineralogy.

Dr. F. W. K. Müller has been advanced to the position of directors assistant in the Museum of Ethnology in Berlin.

Dr. H. F. Reid, of Johns Hopkins University has been advanced to the position of assistant professor of geophysics.

Prof. K. von Kupffer, of Munich, has been elected corresponding member of the Prussian Academy of Sciences.

Dr. V. A. H. Horsley, professor of histology in University College, London, has been made professor emeritus.

Dr. Standenmaier, of Munich, goes to the Lyceum at Friesing as Professor of Chemistry and Mineralogy.

Dr. J. Lerch, well-known for his studies of the Swiss flora, died at Couvet, March 13th of this year.

Canon A. M. Norman is hereafter to be addressed at Houghton-le-Spring, Co. Durham, England.

Dr. F. Kohl has been advanced to the position of ordinary professor in the University of Marburg.

Dr. A. Hosius, professor of mineralogy in the Academy of Münster, died May 11, aged 71 years.

Dr. R. Zuber is now professor extraordinarius of geology in the University of Lemberg.

Dr. A. Zimmermann, of Berlin, goes to the Botanical Gardens at Buitenzorg, Java.

Dr. H. Henking is now professor of zoology in the University of Göttingen.

Prof. W. Tief, of Villach, Carniola, a student of the Diptera, is dead.